SEVERN TRENT SERVICES

AZTEC SERIES 5000

SINGLE AND DOUBLE DISSOLVED OXYGEN (DO) SYSTEMS

and

COMBINED DO and MIXED LIQUOR SUSPENDED SOLIDS (DO-MLSS) SYSTEM

INSTALLATION, COMMISSIONING, OPERATING and MAINTENANCE INSTRUCTIONS

Part No: 04-5002-D
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These instructions describe the installation, operation and maintenance of the subject equipment. Failure to strictly follow these instructions can lead to an equipment rupture that may cause significant property damage, severe personal injury and even death. If you do not understand these instructions, please call Severn Trent Water Purification for clarification before commencing any work at 215-997-4000 and ask for a Field Service Manager. Severn Trent Water Purification, Inc. reserves the rights to make engineering refinements that may not be described herein. It is the responsibility of the installer to contact Severn Trent Water Purification, Inc. for information that cannot be answered specifically by these instructions. **Any customer request to alter or reduce the design safeguards incorporated into Severn Trent Water Purification equipment is conditioned on the customer absolving Severn Trent Water Purification from any consequences of such a decision.**

Severn Trent Water Purification has developed the recommended installation, operating and maintenance procedures with careful attention to safety. In addition to instruction/operating manuals, all instructions given on labels or attached tags should be followed. Regardless of these efforts, it is not possible to eliminate all hazards from the equipment or foresee every possible hazard that may occur. It is the responsibility of the installer to ensure that the recommended installation instructions are followed. It is the responsibility of the user to ensure that the recommended operating and maintenance instructions are followed. Severn Trent Water Purification, Inc. cannot be responsible deviations from the recommended instructions that may result in a hazardous or unsafe condition.

Severn Trent Water Purification, Inc. cannot be responsible for the overall system design of which our equipment may be an integral part of or any unauthorized modifications to the equipment made by any party other that Severn Trent Water Purification, Inc.

Severn Trent Water Purification, Inc. takes all reasonable precautions in packaging the equipment to prevent shipping damage. Carefully inspect each item and report damages immediately to the shipping agent involved for equipment shipped “F.O.B. Colmar” or to Severn Trent Water Purification for equipment shipped “F.O.B Jobsite”. Do not install damaged equipment.

SEVERN TRENT SERVICES, COLMAR OPERATIONS
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REVISION HISTORY

Revisions (DO manual)

Issue	Date	Revisions	Software Version	Approval
Version 1.0 04-5002-B	10/03	First Issue	MADOS V version 1.00 March 2000	D Downie D McGarr
Version 1.1 04-5002-C	10/04	Clark DO Cell part number change in spares list (appendix C)		D Downie
Version 1.2 04-5002-D	12/04	New photographs Installation notes added for systems purchased without pre-wired isolator Mounting pole details added New blanking plugs fitted to pneumatics for shipping / storage Spare parts lists updated Spare parts drawing updated		D G Downie

Revisions (MLSS manual supplement)

Issue	Date	Revisions	Software Version	Approval
Version 5.0 04-5002-B	10/03	First Issue	MADOS V version 1.00a 24/4/2000	D Downie D McGarr

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1 INTRODUCTION

1.1 Scope

This manual describes the installation and maintenance of the ***AZTEC Series 5000 Dissolved Oxygen (DO) System*** with or without additional MLSS measurement. Section 12 onwards provides extra information relating to the instrument featuring additional MLSS measurement. These sections can be ignored by users of DO–only instruments.

The manual includes information to enable safe and continuing operation of the equipment. The manual should be read and understood before the equipment is placed into service.

1.2 Important Notices

1. **SEVERN TRENT SERVICES** reserve the right to make engineering refinements to the equipment that may not be described herein. Any questions that cannot be answered specifically by these instructions should be addressed to **SEVERN TRENT SERVICES** or their agents for response.

2. **SEVERN TRENT SERVICES** will not accept responsibility for any equipment supplied or the actions of such equipment or associated system when the customer has made a modification that is considered by **SEVERN TRENT SERVICES** to be detrimental to the operation of the equipment.

1.3 Intended Audience

This manual is for reference by all scientific, operation or engineering staff using the equipment.

1.4 Using this Manual

This manual contains an initial eleven chapters relevant to DO-only and common features of DO-only and DO/MLSS instruments. These eleven chapters comprise this introduction and ten others:

- **Safety Procedures** – outlines steps that should be taken to ensure safe use of the equipment. This section must be read prior to installation.

- **Design** – gives a brief description of the ***AZTEC Dissolved Oxygen System*** and the function it performs.

- **Specification** – provides technical details of the ***AZTEC Dissolved Oxygen System***.

- **Installation** – describes the recommended method of installation.

- **Commissioning** – provides commissioning details of the ***AZTEC Dissolved Oxygen System***.

- **Operation** – describes the operating modes.

- **Front Panel Access** – describes the access menus and how to use them.

- **Serial Communications** – gives a listing of relevant serial interface commands and their use and meaning.

- **Routine Maintenance** - describes all routine user maintenance tasks.

- **Fault Finding** – general statement concerning fault diagnosis and reference to user manual.

In addition, there are four appendices for DO-only instruments:

- **Appendix A** – Certificate of Conformity

- **Appendix B** – Warranty Exclusions

- **Appendix C** – Spare Parts List

- **Appendix D** – Software Licence Agreement

Following these appendices in sections twelve onwards are the additional sections relating specifically to MLSS in DO/MLSS combined instruments

2 SAFETY PROCEDURES

The recommended installation and operating procedures have been designed with careful attention to safety. **Severn Trent Services** has made formal safety reviews of the initial design and any subsequent changes. This procedure is followed for all new products and covers areas in addition to those included in applicable safety standards.

The following safety precautions should be observed:

1. Observe all safety warnings marked on the equipment. These warnings identify areas of immediate hazard, which could result in personal injury or loss of life.

2. Do not use this equipment for any other purpose other than described in this manual.

3. Only suitably qualified personnel should carry out work on this equipment.

4. Disconnect power to the apparatus prior to making any terminal connections within the electronics enclosures.

   Note: Alarm outputs, if used, are externally powered and could be carrying mains (line) voltage. The instrument's mains power isolator does NOT isolate these circuits. In these circumstances, the installer should provide a separate means of isolation and supplementary warning labels

5. Do not operate the equipment with the electronics enclosure open. Operation without the protective covers may present an electric shock hazard.

6. Use all practical safety precautions to prevent contact with energised parts of the equipment and related circuits.

7. Use the recommended connection procedures described in the installation section.

8. Only suitably qualified personnel should perform installation.

9. When in use, compressors, valves and pneumatic cylinders may all stop and start automatically. Suitable caution should therefore be exercised when working on the unit. If carrying out maintenance work on the DO sensors, entering the maintenance ('9999') menu should disable the automatic mode.

10. DO NOT under any circumstances insert fingers into the space between the sensor and shroud.

11. The DO system is designed to operate in wastewater plants. Removal and maintenance of the wet end assembly poses a potential biological hazard. Protective clothing should be used, open wounds should be protected and skin or mucous membrane contamination should be washed off as soon as possible. If accidental ingestion of biomass or wastewater occurs, medical advice should be sought immediately.

12. The **AZTEC DO system** is often supplied with an integral compressor. On calibration, this may run for an extended period resulting in the motor housing becoming hot. Care should be exercised if the compressor box is cover is removed.

13. Makareth cells are supplied stored in a sodium sulphite solution. Refer to the following Material Safety Data Sheets before handling.

MSDS SHEET:

SODIUM SULPHITE SOLUTION – 3% to 10% w/v in water

Common Names:

SODIUM SULPHITE SOLUTION
SODIUM SULFITE SOLUTION
DO ELECTRODE STORAGE SOLUTION

MSDS Contents – Information on the topics in the list below are provided.

1. PRODUCT IDENTIFICATION
2. COMPOSITION/INFORMATION ON INGREDIENTS
3. HAZARD IDENTIFICATION
4. FIRST AID MEASURES
5. FIRE FIGHTING MEASURES
6. HANDLING AND STORAGE
7. EXPOSURE CONTROL/PERSONAL PROTECTION

MATERIAL SAFETY DATA SHEET

THE FOLLOWING INFORMATION, BASED UPON CURRENT KNOWLEDGE AND EXPERIENCE OF THE PRODUCT IS NOT EXHAUSTIVE. IT APPLIES TO THE PRODUCT AS DEFINED BY THE SPECIFICATIONS. IN CASE OF COMBINATIONS OF MIXTURES, ONE MUST CONFIRM THAT NO NEW HAZARDS ARE LIKELY TO EXIST. IN ANY CASE, THE USER IS NOT EXEMPT FROM OBSERVING ALL LEGAL, ADMINISTRATIVE AND REGULATORY PROCEDURES RELATING TO THE PRODUCT, PERSONAL HYGIENE, AND INTEGRITY OF THE WORK ENVIRONMENT. (UNLESS NOTED TO THE CONTRARY, THE TECHNICAL INFORMATION APPLIES ONLY TO PURE PRODUCT).

1. PRODUCT IDENTIFICATION

1.1 PRODUCT NAME: SODIUM SULPHITE SOLUTION;

1.2 CHEMICAL NAME: INORGANIC SODIUM COMPOUNDS.

1.3 SYNONYMS: DO ELECTRODE STORAGE SOLUTION.

2. COMPOSITION / INFORMATION ON INGREDIENTS

CONSISTS OF AN AQUEOUS SOLUTION CONTAINING TYPICALLY 3g BUT POSSIBLY UP TO 10g ANHYDROUS SODIUM SULPHITE PER 100 ml WATER. DECOMPOSES IN AIR TO SODIUM SULPHATE BY ABSORPTION OF OXYGEN.

3. HAZARD IDENTIFICATION

3.1 ANHYDROUS SOLID SODIUM SULPHITE IS AN ODOURLESS, FREE FLOWING WHITE CRYSTAL. ITS SOLUTION IN WATER IS USED AS A STORAGE MEDIUM FOR SENSORS REQUIRING AN OXYGEN-FREE STORAGE ENVIRONMENT.

3.2 ROUTE(S) OF ENTRY:

INHALATION?	NO
SKIN?	YES
INGESTION?	YES

3.3 EFFECTS OF EXPOSURE:

	MAY CAUSE IRRITATION
EYES:	MAY CAUSE IRRITATION
SKIN:	MAY CAUSE IRRITATION
INGESTION:	ORAL EXPOSURE OR SWALLOWING MAY PRODUCE GASTROINTESTINAL UPSET, NAUSEA OR VOMITING. INGESTION MAY BE FATAL. SULPHITE SENSITIVE INDIVIDUALS MAY EXPERIENCE A SEVERE ALLERGIC REACTION.

3.4 LIBERATES SULPHUR DIOXIDE IN CONTACT WITH MINERAL ACIDS.

4. **FIRST AID MEASURES**

THOROUGHLY RINSE ANY SPILLAGES ON THE SKIN WITH CLEAN WATER. IRRIGATE EYES IMMEDIATELY WITH WATER IF SPLASHED AND SEEK MEDICAL ATTENTION.

SEEK IMMEDIATE MEDICAL ATTENTION IF INGESTED.

5. **FIRE FIGHTING MEASURES**

5.1	FLASH POINT:	NON-COMBUSTIBLE.
5.2	FIRE FIGHTING METHOD:	NOT APPLICABLE
5.3	AUTOIGNITION TEMPERATURE:	NOT APPLICABLE
5.4	FLAMMABILITY LIMITS:	LOWER LIMIT: NON-FLAMMABLE UPPER LIMIT: NON-FLAMMABLE

5.5 UNUSUAL FIRE AND EXPLOSION HAZARDS: IF HEATED TO DRYNESS NON-COMBUSTIBLE. SODIUM SULPHITE GENERATES HAZARDOUS SULPHUR DIOXIDE DURING DECOMPOSITION.

5.6 COMMON EXTINGUISHING METHODS: NOT APPLICABLE

6. **HANDLING AND STORAGE**

QUANTITIES INVOLVED ARE SMALL. HOWEVER, YOU SHOULD STILL WEAR PROTECTIVE GLOVES AND GOGGLES WHEN HANDLING. STORE IN THE CONTAINER PROVIDED AND KEEP THE CONTAINER CAPPED WHEN NOT IN USE.

7. **EXPOSURE CONTROL/PERSONAL PROTECTION**

AVOID DIRECT OR INDIRECT CONTACT WITH THE SOLUTION. WEAR PROTECTIVE CLOTHING, GLOVES AND EYE PROTECTION.

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3 DESIGN

3.1 General Design

In the basic DO System there are two physically separate connected assemblies - the Main System Assembly and the DO Probe Assembly.

In addition to this, where requested, a DO Local Control Box (LCB) can be supplied. One DO Local Control Box is supplied as standard for a double DO probe system for distributing compressed air to the additional DO probe assembly. It enables the user to test the function of an additional DO Probe Assembly local to the extra probe rather than at the main panel.

Figure 1 - Typical arrangement of an AZTEC double DO System

3.2 Main System Assembly

When so ordered the Main System Assembly is normally despatched as a pre-assembled unit and consists of:

1. Main backboard with Unistrut™ channel and pre-wired isolator

2. Electronics Module, solenoid valves and optional compressor.

3.3 DO Probe Assembly

The DO Probe Assembly is normally despatched in a kit form with separate assembly instructions. The DO cell is a fragile device and should be fitted during installation/commissioning.

There may be more than one DO Probe Assembly (i.e. a double DO system) controlled by the Main System Assembly.

The DO Probe Assembly consists of:

1. Mounting bracket (Optional)

2. Support pole (Optional)

3. Wet end assembly (fixed to end of support pole)

3.4 DO Local Control Box (LCB)

This is normally despatched as a pre-assembled unit with a mounting plate attached. It provides all the interface hardware local to the sensor in addition to a facility to test the mechanical operation of the cleaning and calibration components during maintenance.

These three assemblies are described in more detail later.

3.5 Pneumatic Connections

The pneumatic tubes, which run between the assemblies, are connected with 6mm push-fit connectors. Prior to shipping, blanking plugs (part No. 25-5089) are fitted to the panel connectors and these should be removed immediately prior to commissioning. It is recommended that the blanking plugs be re-fitted if the Wet End is disconnected for extended periods. Experience has shown that some insects use the open ends of the pneumatics to nest and consequential partial blockage results in erratic operation.

The push-fit connectors retain the pneumatic tubes by means of a barbed collet, which tightens onto the tube if any force is exerted that could otherwise pull the tube out.

When fitting each pneumatic tube ensure that it passes fully through the “O” ring in the push fit connector or serious malfunctions will occur.

3.6 Operational Principles

The **AZTEC DO system** provides for the user a reliable self-cleaning, autocalibrating dissolved oxygen measuring system, which is capable of storing 15 minute average data, including DO in % saturation and mg/l, temperature and various other useful internally generated parameters. In addition, it stores detailed information every time it carries out a calibration, thus enabling rapid and easy interpretation of its condition.

The instrument has three operating modes:

a) Normal measuring mode

b) Calibration and cleaning mode

c) Manual intervention mode

For the majority of the time the instrument operates in normal operating mode, during which time the sensor (either Clark or Makareth) responds to aqueous DO concentrations by producing a current (microamperes) that is proportional to the DO concentration. The current is fed into a DO head amplifier thus generating a voltage (0 to 5 Volts) proportional to DO, which is then registered in the electronics module via an analogue input channel.

A thermistor in the sensor head also responds to the liquor temperature. The temperature thus recorded is used to convert the percentage saturation readings into mg/l.

The calibration and cleaning modes are initialled either automatically at user settable intervals, or manually via the front keypad.

Cleaning of the sensor is achieved by means of a pneumatically actuated cylinder, which pushes a shroud down over the sensor head. There is an annular brush housed in the end of the shroud, which brushes over the face of the sensing element as the shroud moves.

Moving the sensor into the inside of the shroud and then blowing air through the annular space between shroud and sensor affects calibration. This is continued for a given period to allow equilibrium to be attained, after which the reading is adjusted to give a corrected 100% saturation value.

The manual intervention modes are accessible by typing a code on the front panel keyboard. This will suspend normal operation and allow manual control of the piston and aeration functions. These modes are used for maintenance and diagnostic purposes.

Further detail of operation and the different modes is given in sections 7 and 8.

3.7 Access to Data

Three methods of data access are available:

1. **Front Panel Interface** (Local Mode)

2. **Local Serial Communications Access via a PC or similar**

3. **Remote Serial Communications Access via modem, PSTN and PC or similar**

3.7.1 Front Panel Interface (Local Mode)

Using the front panel interface keypad and display it is possible to check the current state of the instrument and configure, test and alter basic aspects of its setup. Further details on the use of the keypad can be found in section 8.

Advanced configuration of the instrument must be carried out via the serial communications. **Severn Trent Services** staff should be consulted before attempting this.

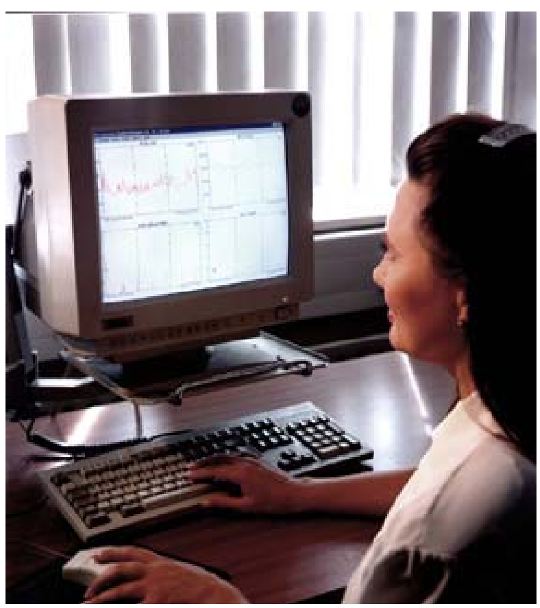
3.7.2 Local PC Access (Serial Communications)

An RS232 serial port is available. A connector socket is provided for local PC access or other suitable ASCII terminal connection. More information on serial communications connection may be found in Section 9 Serial Communications.

Both stored fifteen-minute averages and detailed area can be recovered from the processor onto a PC using a specially designed software suite, and the resultant data can be displayed and manipulated in a in a variety of ways. In addition, it is possible to access the main control program to interrogate the instrument to determine its current operating settings or to make modifications. For further information, please request literature on the PC Software suite (under separate cover).

3.7.3 Remote PC Access

Exactly the same features outlined in the previous section are available remotely, provided an error-correcting modem is connected to the serial communications connections, and the modem is linked to the PNTN network.



Remote communications via PC, modem and PSTN

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4 - DO TECHNICAL SPECIFICATION

Table 1** – General Specification for the **AZTEC Dissolved Oxygen System

ITEM	DESCRIPTION
Compliance	The unit complies with all relevant directives of the European Union and is CE marked to indicate this
Instrument parameter Ranges	Temperature: 0 to 50 Degrees C DO: 0 - 130% Saturation 0 - 10 mg/l (These are default values. Both are user re-configurable)
Measurement Principles	Temperature: Thermistor Dissolved Oxygen: Clark Type cell or Makareth cell
Measurement Mode	Continuous
Accuracy	Temperature: Better than 0.1 Deg C Dissolved Oxygen: Better than 1% Saturation
Analogue Outputs	4 – 20 mA into 1000 ohms Four parameters, configurable Connection via minimum of: twisted pair, individually screened, overall screened cable.
Digital outputs	Four (user configurable): Each channel comprising single pole changeover (SPCO) volt-free contact rated at 1A @ 250Vac with internal VDR suppressers fitted. LED indication of each relay output provided.
Serial Communications	RS232 or as an option RS422 available. Connection via minimum of: 3 twisted pair, individually screened, overall screened cable
Local Display	LCD two-line, 40-character alphanumeric
Local Keypad	Numeric membrane type
Power Supply	110/120VAC or 230VAC, 50-60Hz +/- 10%
Power Consumption	300VA if integral compressor fitted, 30VA if not
Ambient operating Temperature	-10 to +50 Degrees C
Liquid operating Temperature	0 to +45 Degrees C

ITEM	DESCRIPTION
Mounting	Main panel: vertical on handrails or site-specific frame Probe assembly: A stainless steel handrail bracket supports a 2.5 Metre long pole made from 1½" nominal ABS Class T pressure pipe 48mm OD x 6.35mm wall thickness. This pole has an undercut 1¼" British Standard Pipe Parallel thread (BSPP) (11 TPI Whitworth thread form) machined one end. The shoulder, formed by the undercut, is a sealing surface utilised by the square section "O" ring in the end face of the cylinder rod. THIS ARRANGEMENT MUST NOT BE SUBSTITUTED. All threaded fasteners ISO metric stainless steel.
Dimensions	Height Width Depth Without compressor 880mm 400mm 269mm With compressor 880mm 800mm 269mm Weight approximately 27Kg Pole assembly Normal Length 2.5m Extended pole 3.5m or 5m
Enclosures	GRP IP67 and NEMA 4X
Air Supply	Pressure: nominal 2 bar max. Must be fed through a regulator Flow at atmospheric pressure: 1 L/s maximum Connection: 6 mm push fit to take nylon tube Air Quality: Instrument quality Compressor normally provided

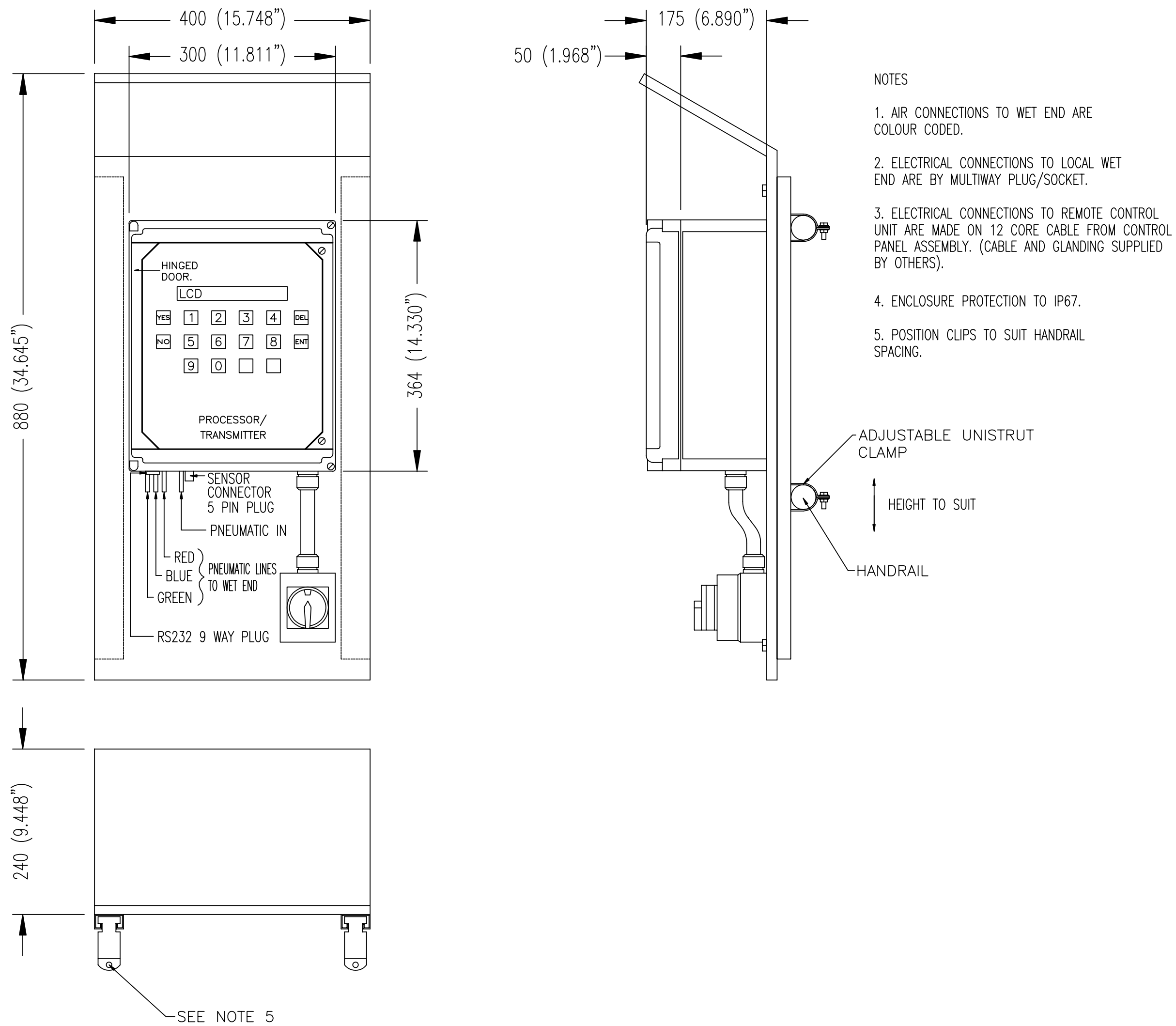


Figure 2 - System Dimensions (with optional mounting panel) – units in millimetres

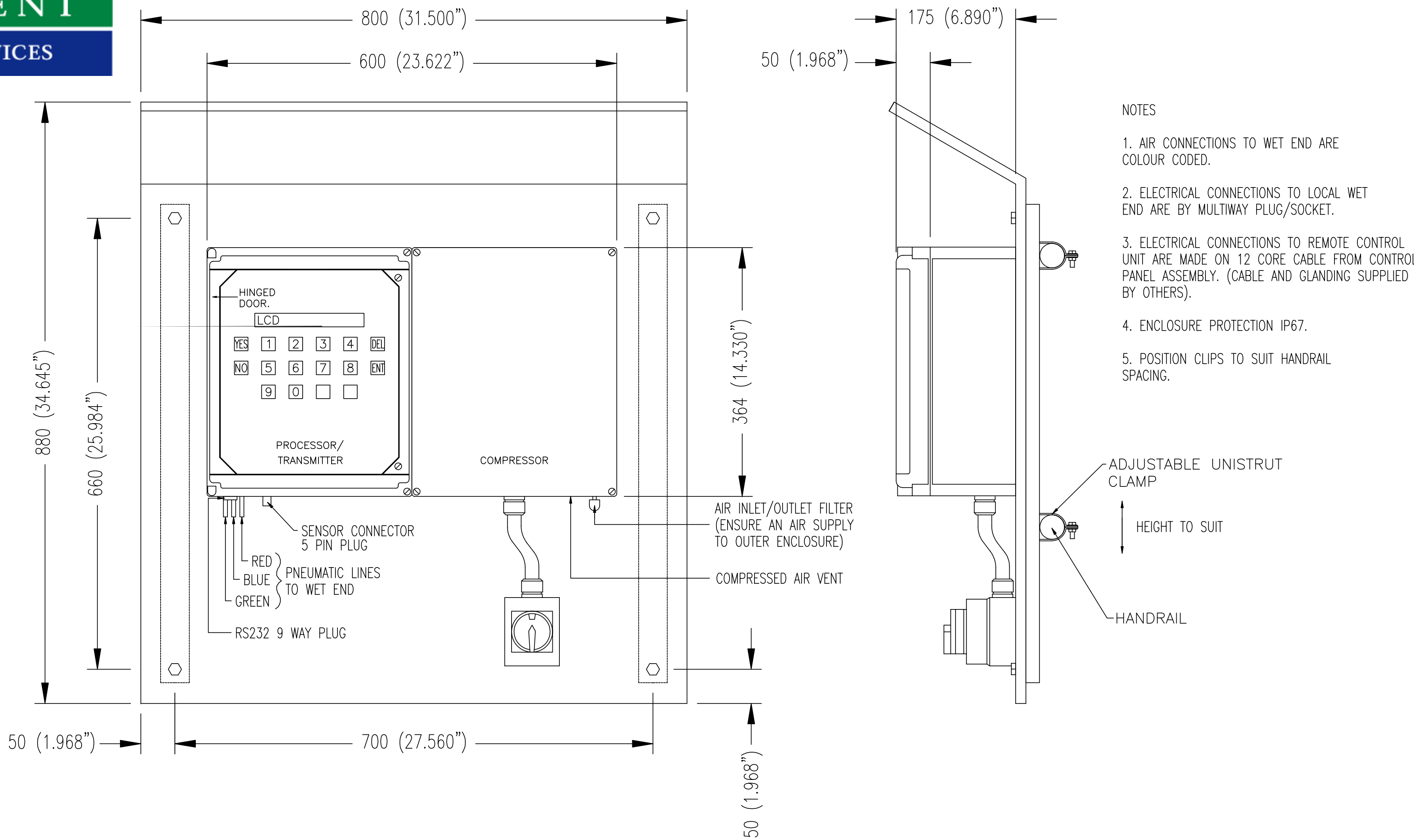


Figure 3 - System Dimensions (with optional mounting panel & integral compressor) - units in millimetres

5 INSTALLATION

5.1 General Rules

It is important that the installing engineer fully reads this manual prior to installation. To achieve successful operation, the correct installation and location of the ***AZTEC DO System*** is vital. Incorrect installation may result in premature life expiry of the DO Probe Assembly components and unrepresentative DO data may be obtained.

It is important that no "short-cuts" are taken.

Analogue signal and data communications conductors must be segregated from each other by screening, and from cables operating at different voltage classifications. This specifically relates to the cabling from the DO Probe Assembly, cabling from the Main System Assembly and any other plant cabling in the vicinity of the ***AZTEC DO System.***

Reference should be made to the Electricity Supply Regulations, the current Edition of the IEE Wiring Regulations and supporting documents (ERA, BSI and ISO standards publications).

Owing to the site-specific nature of process liquors, it is beyond the scope of this document to detail exact sensor location within a process area.

SEVERN TRENT SERVICES offer to provide customer support where site-specific advice is needed. Alternatively, **SEVERN TRENT SERVICES** is able to provide an installation service. **In spite of these uncertainties a number of general installation "rules" should be considered as detailed below:**

5.1.1 Recommended Locations

The installer must ensure that the ***AZTEC DO System*** assemblies are located to provide safe and easy access for the users and maintainers of the system. Successful existing installations have the Main System Assembly and the DO Probe Assembly adjacent to each other, and mounted on hand railing where this permits. The Main System Assembly when ordered is supplied with fittings to allow direct mounting on hand railing or similar support structure. The mounting height of the Main System Assembly should be between 1 metre and 2 metres above local floor level and front access must not be restricted.

The protection rating of the main system unit is IP67 and care should be taken that the installation will not compromise the integrity of the protection.

It is advisable to locate the DO Probe Assembly away from areas that are known to have:

a. Excessive organic growth patterns
b. Excessive levels of surface layer turbulence
c. Surface “scum/foam” accumulation.
d. Unrepresentative DO concentrations.

5.1.2 Personnel Skill Level

Electrical power connections must be carried out and commissioned by electrically competent authorised personnel who are fully conversant in the requirements of the intended installation. Instrumentation staff having at least technician status should carry out the remaining installation.

5.1.3 Test Equipment and Tools

WARNING

High voltage insulation test equipment (e.g. Megger tester) MUST NOT BE USED on the AZTEC DO or DO/MLSS Systems – severe damage may result and the warranty will become void.

The following tools and equipment are recommended for use during the commissioning exercise:

a. Flat blade terminal screwdriver
b. 5mm flat blade screwdriver
c. Multimeter (20mA / 50VDC / 500VAC / continuity range)
d. 17mm deep-socket wrench (spanner)

With respect to the multimeter, the attention of the commissioning engineer is drawn to the 1000-ohm maximum drive capability of the ***AZTEC DO System*** analogue signals.

The commissioning engineer must also be aware of the need for fused test leads for use in conjunction with any test meter, silicone **grease** for the Clark cell assembly and silicone **rubber** for the Makareth cell assembly.

5.1.4 Pre-commissioning checks and tasks

On receipt, the completeness of the **AZTEC DO System** should be checked against the parts list. Any shortfall in the delivery of signs of damage should be notified in accordance with the terms of sales/warranty.

Installation should be carried out in three parts:

a. Physical location and installation of the main electronics panel and in the case of a double DO system, the local control box.

b. Assembly, location and installation of sensor assemblies

c. Power, signal and commissioning wiring. Pneumatic tube connection

Details of the above are provided on the following pages.

5.2 Installation of Main Electronics Panel

The main system unit consists of either two or three modules mounted on a single polypropylene backboard.

The diagrams below show the typical layouts of the Main System Assembly both with and without an integral compressor.

Figure 4 - Main electronics panel without integral compressor

Figure 5 - Main electronics module with integral compressor & optional mounting panel

When so ordered, the units will be supplied on a polypropylene mounting board with Unistrut™ channel affixed to the rear face. In addition, a pre-wired isolator and Unistrut™ pipe clamps are provided, such that the whole assembly may be easily hung from handrails.

If an alternative mounting system is required then the Unistrut™ channel may be removed and the predrilled holes used for fixing by alternative means.

☞ In a double-DO system, the main panel should be installed adjacent to the first DO sensor assembly.

5.3 Physical Installation of Local Control Box

One local control box is normally supplied as standard with a double DO system.

The local control box contains the DO sensor head amplifier, pneumatic valves and wiring terminals for connection to the main panel for the wet end assembly situated remotely from the main electronics panel.

<u>Front view</u>

Figure 6 – Local Control box – Front view showing buttons

<u>View of base</u>

Figure 7 – Local control box – view of base showing connectors

5.3.1 Local Control Box Mounting

The local control box is supplied with the mounting plate already fixed to the box. The mounting plate should be fitted to the same mounting bracket securing the DO Probe Assembly. The plate is supported by the two V" bolt nuts nearest the locking wings which should be tightened down onto the mounting plate. See the diagram below for the positioning of the box onto the handrail-clamping bolt.

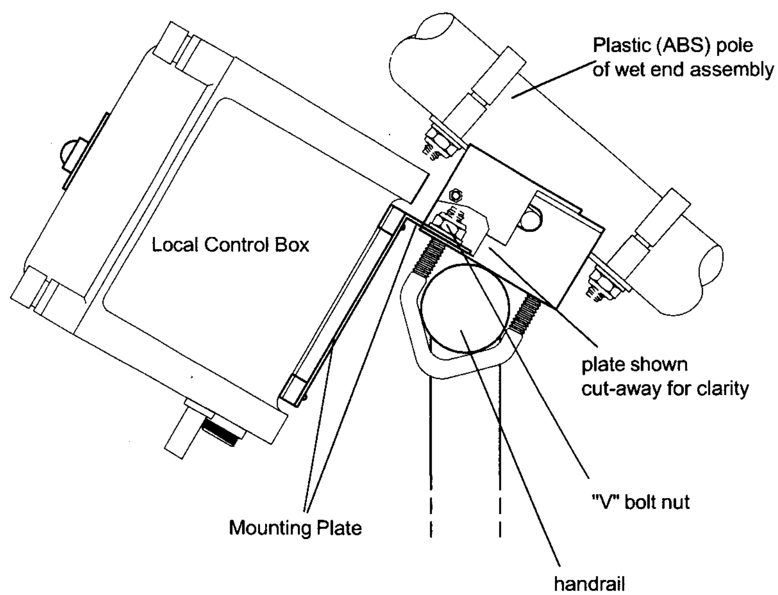


Figure 8 - Diagram showing the local control box mounting arrangement

5.3.1 Local Control Box Pneumatics

The colour-coded pneumatic tubes are fitted into the push-fit connectors as shown previously.

The air tubes from the probe are colour-coded red, green and blue.

Red	-	top of pneumatic cylinder
Green	-	bottom of pneumatic cylinder
Blue	-	aerate line down centre of support pole

The air supply, which may be from the Main System Assembly or from a site supply, is 6 mm nylon tube to BS5409 standard.

5.4 Main Probe Assembly Installation

5.4.1 General Description

When so ordered, the DO Probe Assembly will consist of the following options:

a) Mounting bracket
b) Support Pole
c) Wet-end assembly (fixed to the end of the support pole)

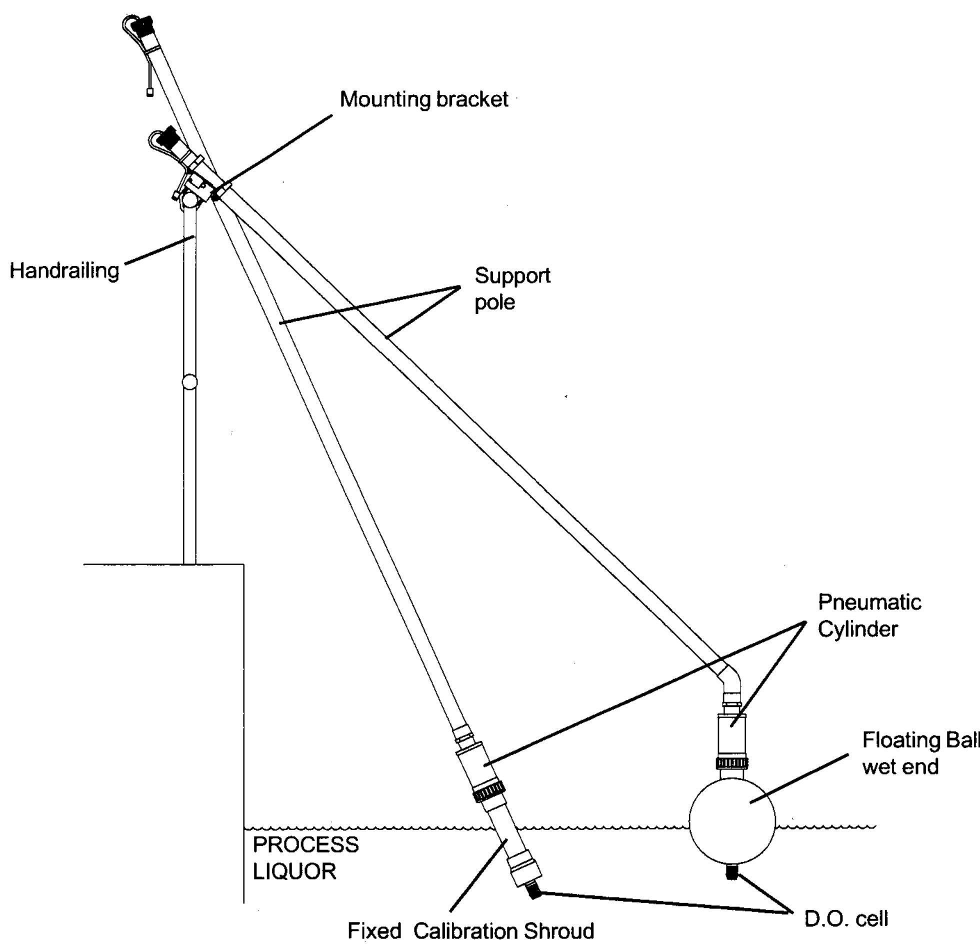


Figure 9 - Drawing showing installations of the floating ball and fixed shroud wet end DO assemblies.

5.4.2 Mounting Bracket

The optional mounting bracket shown below is suitable for direct mounting to handrail horizontal members of diameters up to 45mm.

The static parts are manufactured from stainless or galvanised steel and require no maintenance.

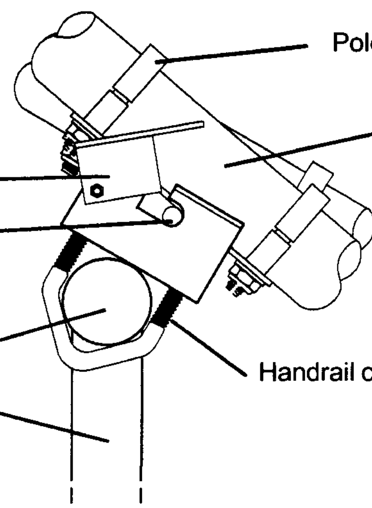


Figure 10 - Drawing of a mounting bracket demonstrating the pivoting action by showing the pole in two positions.

Mounting

The optional bracket, described and shown above, allows the probe assembly to be secured to a handrail by means of an extension pole. Handrail strength must be sufficient for both the original purpose and the additional loading imposed by the DO Probe Assembly.

If the probe is not to be mounted on a handrail, please seek advice from Severn Trent Services.

Bracket installation will require the use of a 17mm A/F deep socket wrench (spanner).

To ensure correct operation of the hinged locking cams, they must move freely without sticking or binding. Adjustment of the M6 securing nuts may be necessary.

The bracket is fitted using two “V” bolts around the handrail section. The orientation is important. The bracket mounts with the hinged locking cams on the top site of the bracket nearest to the installer. This is to ensure that the two pins on the pole bracket will drop into the slots and slide under gravity. The locking cams prevent the pins moving back up the slots and disengaging from the bracket.

For systems using a pole and shroud rather than a floating ball the bracket will need to be rotated on the handrail to ensure that the pole of the wet end is supported at an appropriate angle.

For floating ball installations, the bracket should be rotated such that the pole can move up and down with the ball movement without fouling on the fixed part of the bracket.

Attitude

Installation and location of the bracket and support pole must ensure free vertical movement of the support arm as previously mentioned.

The length of the support pole plus the point of bracket fixture must ensure that:

a) The vertical axis of the wet end assembly is 20 to 30 degrees from true vertical to prevent air pockets developing near the DO sensor, which can result in false measurements being made.

b) The base of a wet end assembly is in full contact with the process liquor and is submerged 200mm. Please contact **Severn Trent Services** for advice on other depths of immersion, (for instance, complete immersion of the cylinder and shroud for local environmental reasons).

Minor changes to support pole length are made by adjusting the clamping position of the bracket on the support arm. Care should be taken that such adjustments do not result in restriction of walkway access.

For the DO Makareth type wet-end assembly the support pole is maintained at a static pressure of 200mm of Water dependant on immersion depth and must not be cut after installation. Pressure seal integrity may be affected if the length of the support arm is changed by unauthorised means. This would compromise calibrations.

5.4.3 Support Pole

The wet end assembly support pole normally consists of one straight length of ABS pipe and ABS pipe fittings.

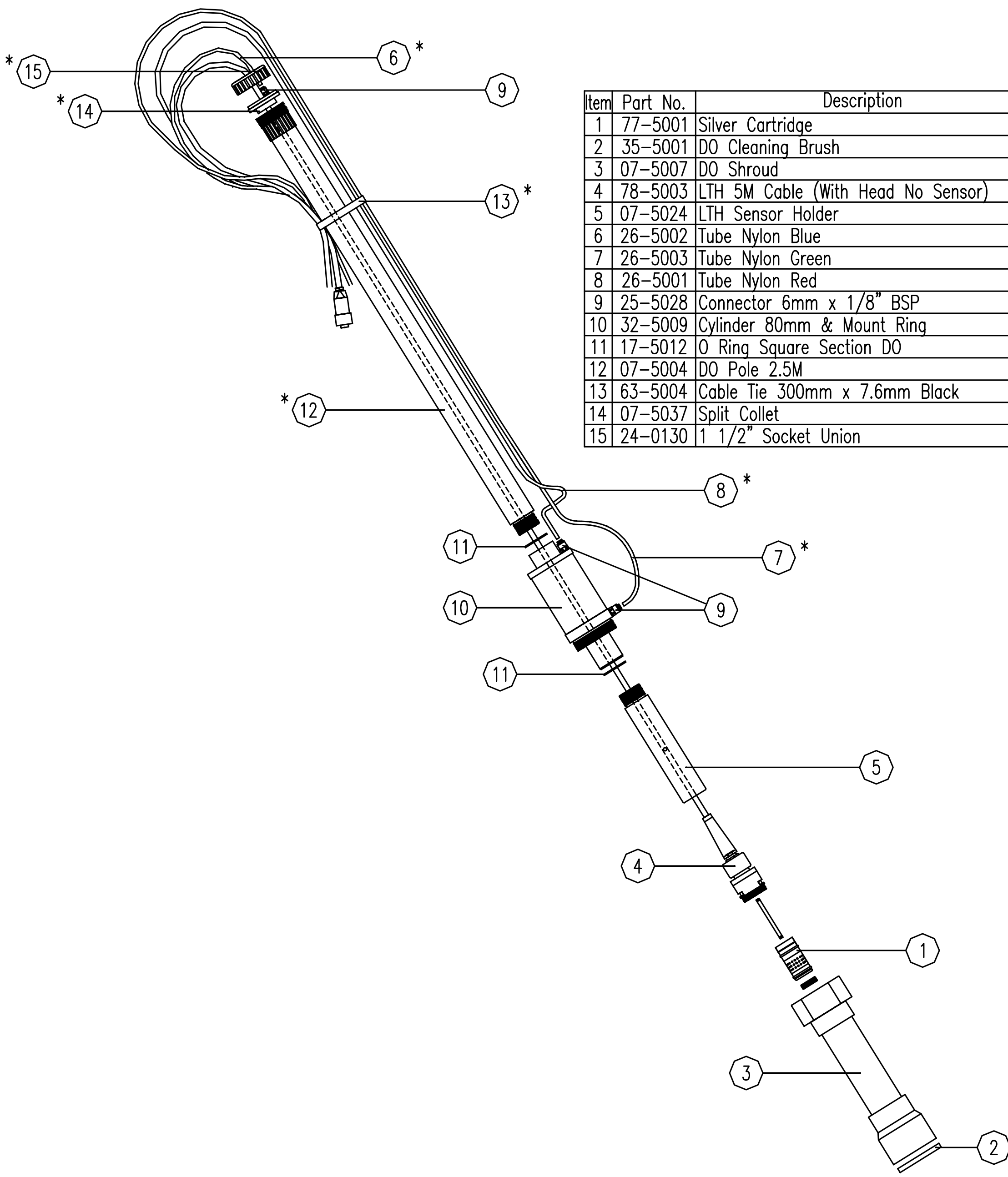
The length of the straight pipe is often tailored to suit local requirements established at time of order. To avoid excessive flexing of the support pole it is recommended that the straight pipe length should not exceed 3.0 metres.

5.4.4 Types of DO wet end Assembly

The DO wet end assembly will be one of two types:

- Makareth cell wet-end assembly
- Clark cell wet-end assembly

The installation of both types is described in detail beginning overleaf.



Item	Part No.	Description
1	77–5001	Silver Cartridge
2	35–5001	DO Cleaning Brush
3	07–5007	DO Shroud
4	78–5003	LTH 5M Cable (With Head No Sensor)
5	07–5024	LTH Sensor Holder
6	26–5002	Tube Nylon Blue
7	26–5003	Tube Nylon Green
8	26–5001	Tube Nylon Red
9	25–5028	Connector 6mm x 1/8" BSP
10	32–5009	Cylinder 80mm & Mount Ring
11	17–5012	O Ring Square Section DO
12	07–5004	DO Pole 2.5M
13	63–5004	Cable Tie 300mm x 7.6mm Black
14	07–5037	Split Collet
15	24–0130	1 1/2" Socket Union

Figure 11 - Diagram of Makareth DO Wet End Assembly

* Optional Extras

5.5 Assembly of *Makareth* DO wet end

The wet-end assembly is supplied in kit form and consists of:

- A plastic ABS pole (optional)
- A pneumatic cylinder and two black moulded 'O' rings to fit in the piston rod faces
- A sensor extension
- A sensor mounting head and cable
- A *Makareth* DO cell
- A calibration/cleaning shroud/ball
- A cable sealing collet (optional)
- Assembly instructions
- Pneumatic tubing (optional)

Assembly of the wet-end should be carried out as follows:

5.5.1 Fitting the pneumatic cylinder to the plastic [ABS] pole

Remove the cylinder from the protective bag. Screw it onto the thread on the pole ensuring that the seal is in place in the groove of the piston rod and that the white threaded ring is furthest from the pole and that the push fit fittings are in place.

☞	Use firm hand tight force – DO NOT USE TOOLS

5.5.2 Fitting the sensor extension to the pole assembly

Remove the DO Sensor extension tube from the fitting pack. Keep the cable ties for later use. Remove the thread protection cap. Ensure that the second black seal is in place. Fit the extension tube into the cylinder (previously fitted to the pole) ensuring that the threads are not crossed and the "O" ring makes the correct seal.

☞	Use firm hand tight force – DO NOT USE TOOLS

5.5.3 Fitting the sensor head and cable to the sensor extension

Before proceeding, it is necessary to remove the split collet at the top of the pole by unscrewing the clamping ring and removing the two halves. Put the collet in a safe place and refit the clamping ring.

The sensor head is a black plastic component attached to 5 meters of cable fitted with a multi pin plug. Feed the cable up the pole until the sensor head engages with the sensor extension. The sensor head should be secured using the two M3 grub screws in the side of the extension.

5.5.4 Fitting the *Makareth* DO Cell

The *Makareth* DO cell is supplied in a cell storage holder that contains a solution of sodium sulphite. This ensures that the membrane remains wet and in good condition. The membrane is delicate and may be damaged by careless use. Inspect the electrode for signs of membrane damage and replace it if necessary.

WARNING

The Makareth cell is like a battery, slowly running down as it measures oxygen. It is supplied stored in an oxygen-absorbing solution and should be kept in the solution when not in use. This is a 3-10% w/v solution of sodium sulphite in water. Although only small quantities are involved, this is a potentially hazardous chemical and must be handled appropriately. Please refer to the example **MSDS** in **Part 2 - Safety** for further information.

The cell needs to be removed from the storage holder and attached to the DO sensor head on the wet-end as follows:

(i) Removing the *Makareth* DO cell from its holder

- Unscrew the end cap of the cell storage holder taking care not to spill the solution inside.
- Take care not to allow contact between the holder and the DO cell.
- Hold the end cap in one hand and unscrew the knurled nut.
- Whilst holding the end cap in one hand grasp the cell with the other hand and firmly pull it away from the end cap.
- Place the cell on a smooth surface.
- Unscrew the rod protruding from the end cap.
- Screw the end cap back on the storage holder and put it in a safe place in case you need to return the cell for refurbishment.

Figure 12 - Makareth cell and storage holder

(ii) Fitting the *Makareth* DO cell to the sensor head

- Carefully screw the rod into the bottom of the sensor head.
- Carefully slide the cell onto the rod, align the contact pins and push firmly home.
- Screw the knurled nut onto the bottom of the cell.
- Finally, inspect the membrane for damage and refer to the manufacturer's instructions if necessary.

Figure 13 - Diagram showing the fitting of Makareth DO cell

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5.5.5 Fitting the calibration shroud/ball

The calibration shroud or ball is supplied with a cleaning brush fitted in the bell mouth. The brush is located in a groove, is secured by its own spring pressure, and can easily be removed by hand if necessary.

Slide the shroud or ball over the sensor assembly taking great care to avoid contact with the cell membrane. Ensure that the 'O' ring seal is against the pneumatic cylinder and tighten the clamping ring by hand.

☞ Use firm hand tight force. Do not use tools

In order to protect the ***Makareth*** DO cell when handling the probe push the pneumatic cylinder down by hand so that the sensor is inside the calibration shroud/ball.

SEVERN TRENT SERVICES

5.5.6 Connecting the pneumatic tubes

Please refer to the pneumatic connection diagrams…

Figure 6 – Local Control box – Front view showing buttons
Figure 7 – Local control box – view of base showing connectors
Figure 18 - Main System Assembly showing external connections

The colour-coded pneumatic tubes are fitted into the push fit connectors as shown in Figure 11 - Diagram of Makareth DO Wet End Assembly, after first removing the blanking plugs.

Red	-	moves the sensor into the process
Green	-	moves the sensor into the shroud
Blue	-	aerates probe for calibration

The green and red tubes must be fitted so that there is sufficient slack to allow free movement of the pneumatic cylinder.

5.5.7 Sealing the pole (Makareth wet end only)

The probe must be sealed in order that the calibration air will reach the sensor. The calibration must pressurise the pole to the same pressure as that exerted by the hydrostatic head at the depth of immersion in order to displace the process liquor and calibrate the sensor. Any leaks will prevent calibration from taking place. Sealing is achieved using a split collet around the cable as follows:

Apply a liberal coat of silicone rubber to the collet to maintain an effective seal. Secure the collet using the clamping ring on top of the pole. Wipe away excess silicone rubber.

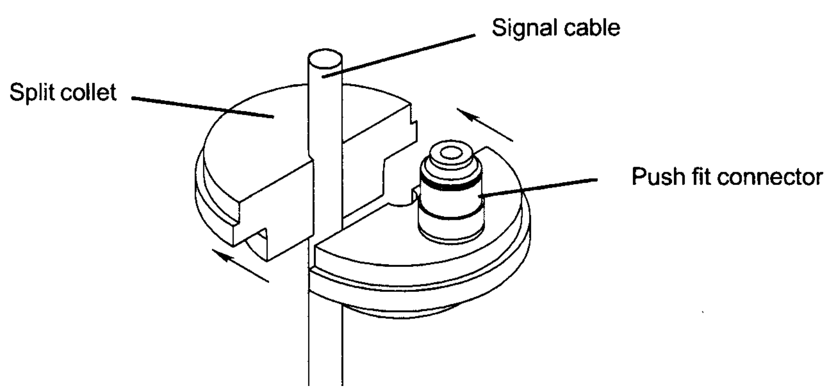


Figure 14 - Diagram of split collet for Makareth wet end

5.5.8 Securing the pneumatic blue tube and the sensor cable

Loop the sensor cable and blue pneumatic tubes to the top of the pole using a cable tie (see Figure 11 - Diagram of Makareth DO Wet End Assembly). This will prevent any unnecessary stress on the cable and tube.

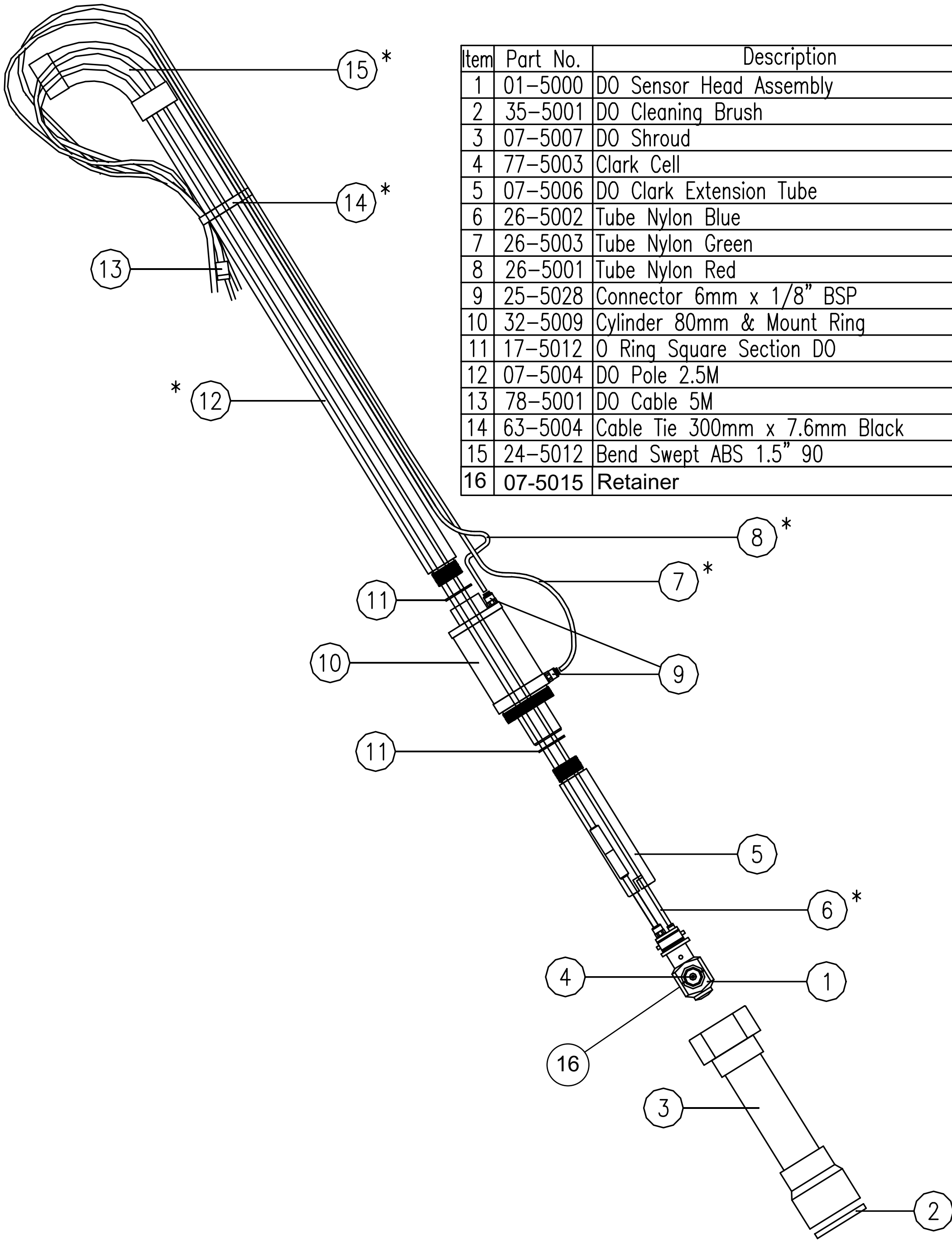
5.5.9 Air Supply

Two air-supply options are available:

- (i) A self-contained compressor unit
- (ii) Site air supply

For option (i) no further tube connections are necessary as the instrument is pre-assembled and tested.

For option (ii) a local site dry air supply rated at 2.0 bar should be used.



Item	Part No.	Description
1	01–5000	DO Sensor Head Assembly
2	35–5001	DO Cleaning Brush
3	07–5007	DO Shroud
4	77–5003	Clark Cell
5	07–5006	DO Clark Extension Tube
6	26–5002	Tube Nylon Blue
7	26–5003	Tube Nylon Green
8	26–5001	Tube Nylon Red
9	25–5028	Connector 6mm x 1/8" BSP
10	32–5009	Cylinder 80mm & Mount Ring
11	17–5012	O Ring Square Section DO
12	07–5004	DO Pole 2.5M
13	78–5001	DO Cable 5M
14	63–5004	Cable Tie 300mm x 7.6mm Black
15	24–5012	Bend Swept ABS 1.5" 90
16	07-5015	Retainer

Figure 15 – Diagram of Clark cell DO Wet End Assembly

* Optional Extras

5.6 Assembly of *Clark* DO wet end

The wet-end assembly is supplied in a kit form and consists of:

- A plastic (ABS) pole and swept bend (optional)
- A pneumatic cylinder and two black moulded 'O' rings to fit in the piston rod end faces
- A sensor extension tube
- A sensor head and cable connector
- A *Clark* DO cell (packaged) and retaining ring key
- A calibration/cleaning shroud/ball
- Assembly instructions
- Pneumatic tubing (optional)

Assembly of the wet-end should be carried out as per the kits enclosed assembly instructions, which are summarised below and overleaf.

5.6.1 Fitting the pneumatic cylinder to the plastic (ABS) pole

Remove the cylinder from the protective bag. Screw it onto the thread on the pole ensuring that the seal is in place in the groove of the piston rod and that the white threaded ring is furthest from the pole and that the push fit fittings are in place.

☞ Use firm hand tight force – DO NOT USE TOOLS

5.6.2 Fitting the sensor extension to the pole assembly

Remove the DO sensor extension tube from the fitting pack. Keep the cable ties for later use. Remove the thread protection cap. Ensure that the second black seal is in place. Fit the extension rube into the cylinder (previously fitted to pole) ensuring that the threads are not crossed and the 'O' ring makes the correct seal.

☞ Use firm hand tight force – DO NOT USE TOOLS

5.6.3 Fitting the sensor head and cable to the sensor extension

The sensor head is a plastic component fitted with a multi-pin plug for connecting to the 5-metre long extension cable. Lubricate the "O" rings with silicone grease. Feed the cable up the pole ensuring that it does not become twisted with the blue pneumatic tube inside the pole. Connect the blue pneumatic line from inside the pole to the push fit connector on the sensor head (see section 3.5 for instructions

on these connectors). Screw the in-line cable connectors together. Push and twist the sensor head into the bayonet fixture.

5.6.4 Fitting the *Clark* type cell

Remove the retaining ring from the sensor head using the special tool provided (illustrated right).

Unpack the new *Clark* DO cell and install it into the sensor head, ensuring that it locates into its mating parts correctly. The cell block is coated in silicone grease to repel moisture. Do not remove this grease.

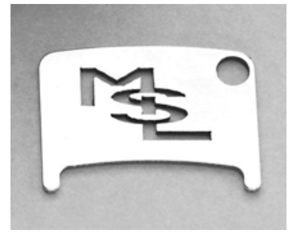


Figure 16 - Clark DO cell retaining ring key

Taking care not to damage the cell membrane or transfer any silicone grease onto the membrane, screw the retaining ring over the cell

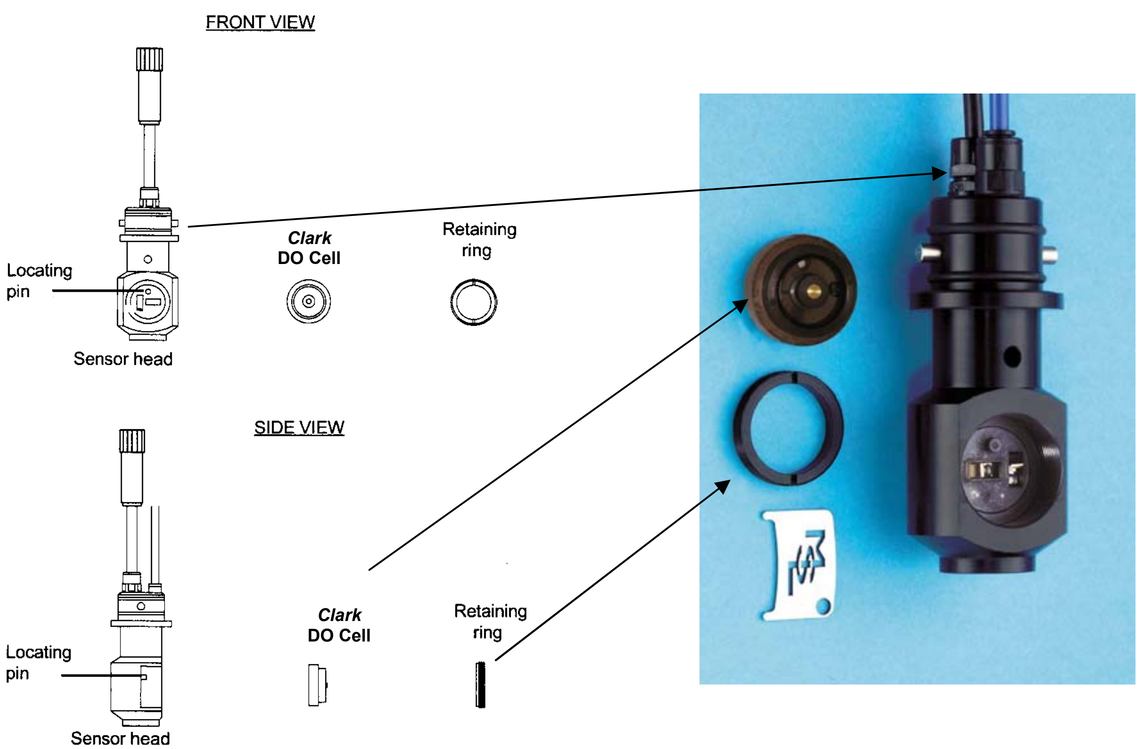


Figure 17 - Illustrations showing the fitting of the Clark DO cell

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5.6.5 Fitting the calibration shroud/ball

The calibration shroud or ball is supplied with a cleaning brush fitted in the bell mouth. The brush is located in a groove and is secured by its own spring pressure and can easily be removed by hand if necessary.

Slide the shroud or ball over the sensor assembly taking great care to avoid contact with the cell membrane. Ensure that the “O” ring seal is against the pneumatic cylinder and tighten the clamping ring by hand.

☞ Use firm hand tight force. Do not use tools

In order to protect the *Clark* DO cell when handling the probe push the pneumatic cylinder down by hand so that the sensor is inside the calibration shroud.

5.6.6 Connecting the pneumatic tubes

Please refer to the pneumatic connection diagrams on pages 18, 29 and 36. The colour coded pneumatic tubes are fitted into the push fit connectors as shown in the diagram, after first removing the blanking plugs.

Red	-	Moves the sensor into the process
Green	-	Moves the sensor into the shroud
Blue	-	Aerates probe for calibration

The green and red tubes must be fitted so that there is sufficient slack to allow free movement of the pneumatic cylinder.

5.6.7 Air Supply

Two air supply options are available: (i) Self-contained compressor unit
(ii) Site air supply

For option (i) no further tube connections are necessary as the instrument is pre-assembled and tested.

For option (ii) a local site dry air supply rated 2.0 bar should be used.

5.6.8 Fitting the plastic 90° Bend

The 90° bend should now be fitted. Remove the bend from the fitting kit. Thread the blue pneumatic tube and signal cable through the bend and push the bend onto the pole ensuring that when the pole is fitted the bend faces down for weather protection.

For systems supplied without a pre-wired back panel or compressor, please refer to fig.21 page 44, fig.22 page 46 or fig.23 page 48

5.7 Wiring Details

5.7.1 Power Connections

The operating voltage of the ***AZTEC DO System*** is readily confirmed from the label attached to the equipment and will normally be either 110 Volt AC or 230 Volt AC.
To allow for correct labelling during manufacture, and selection of the appropriate compressor option if required, the operating voltage must be stated at the time of order. The power supply must comply with the following requirements.

115 or 230Va.c.@50/60 Hz (+/- 10%)

The main incoming power supply cable is terminated as indicated. It is recommended that the incoming power supply cable is armoured and should be glanded using first quality brass glands fitted with locknuts, earth tag and PVC over-shroud. Final cable termination is at the terminal provided at the isolator feed side.

<u>Pre-wired Back Panel</u> **<u>No pre-wired Back Panel</u>**

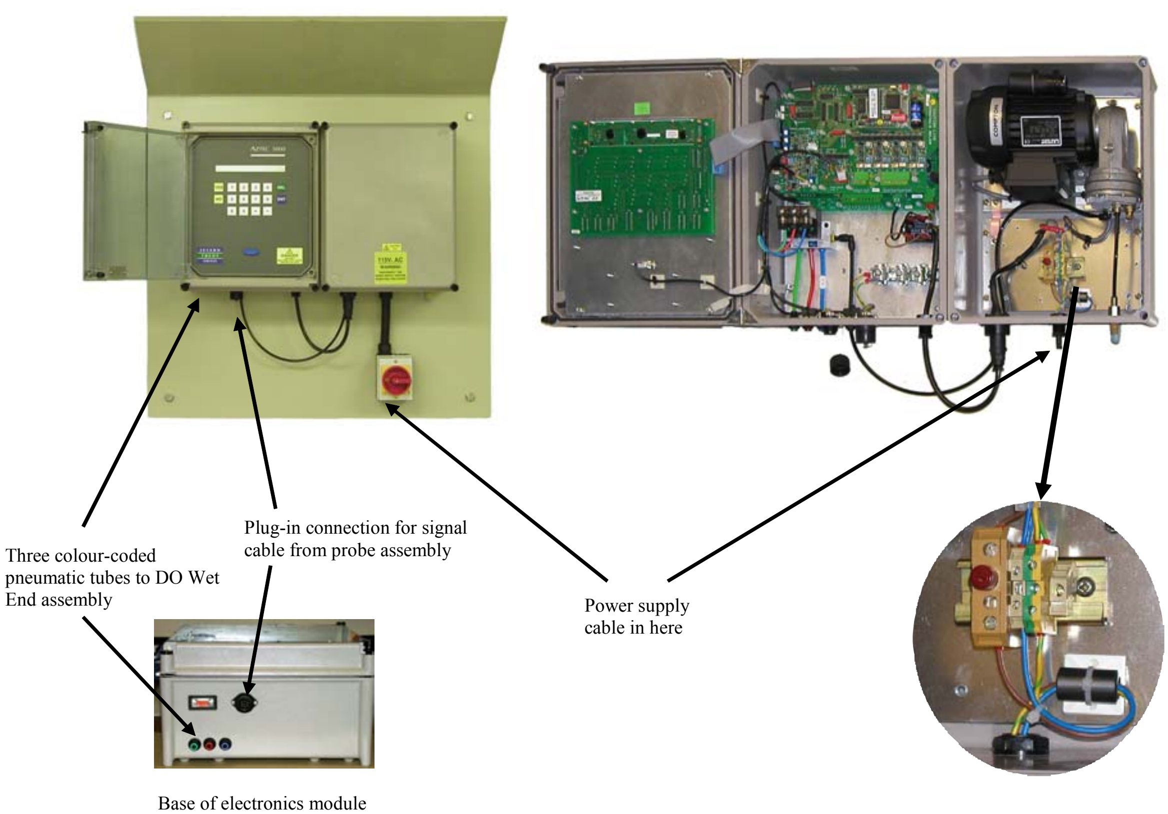
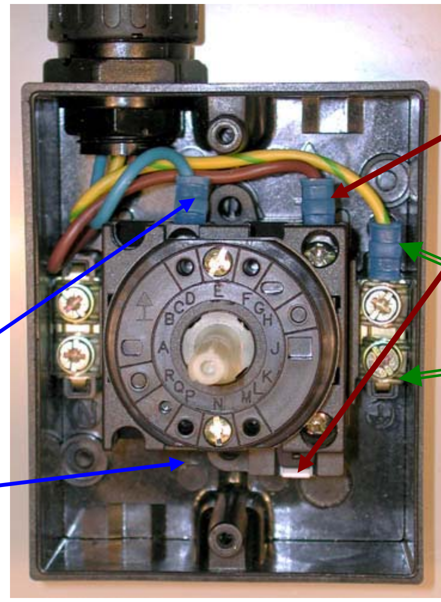


Figure 18 - Main System Assembly showing external connections

Mains (line) isolator …

Isolator –
With cover removed



Isolator (Off)
With cover fitted

Figure 19 - Diagram showing mains (line) power connectors

5.7.2 Main System Assembly and Local Control Box interconnections

This sub-section applies to double units and single with a remote probe with a LCB

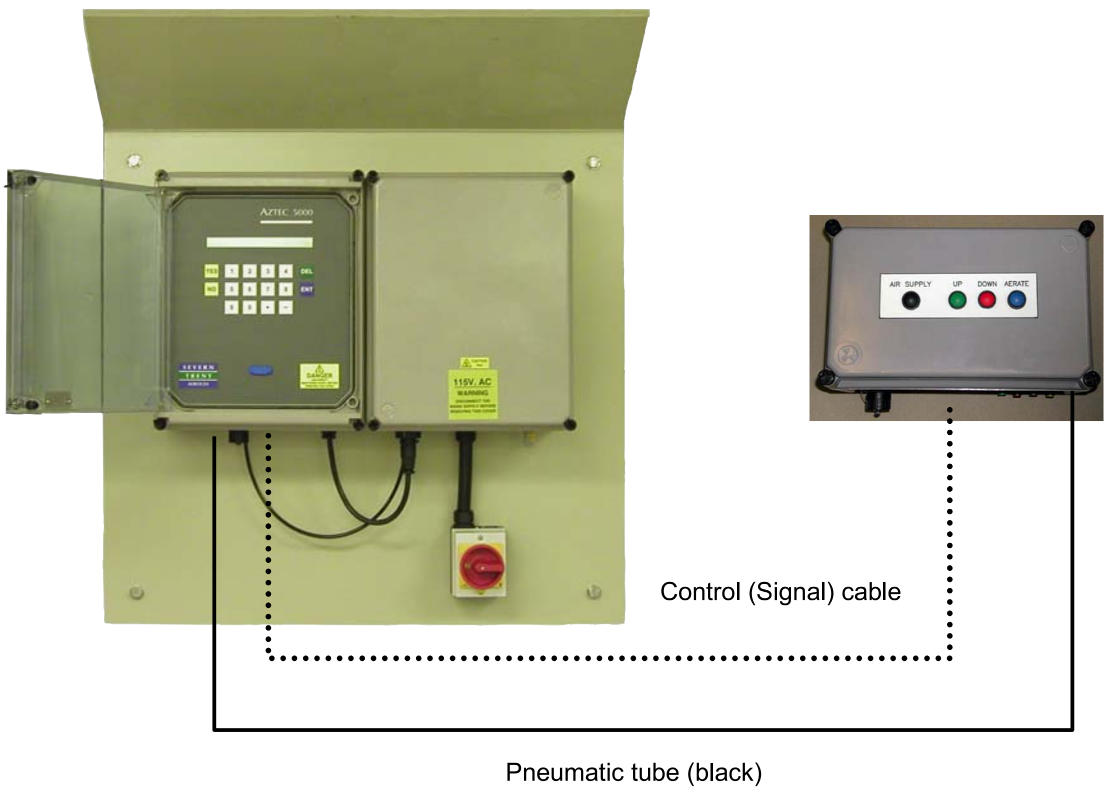


Figure 20 - Diagram showing control (signal) cable between Main System Assembly and Local Control Box

Electrical: There are no mains supply connectors for the local control box.

The signals from the sensor are connected via a pre-wired multi-way plug and socket.

The link between the electronics module and the Local Control Box requires a 12-core screened cable connected to the terminals, and the screen itself connected to the chassis plate.

The cable recommended for the control (signal) cable is:

16/0.2 mm (0.5mm^2), 12-core with overall tinned copper braided sheath and PVC outer. R.S. Components PLC part Number 367-757, alternatively, Belden Type 9261 12 core cable or equivalent. See section 5.7.3 for details of the terminal connections.

IMPORTANT NOTE

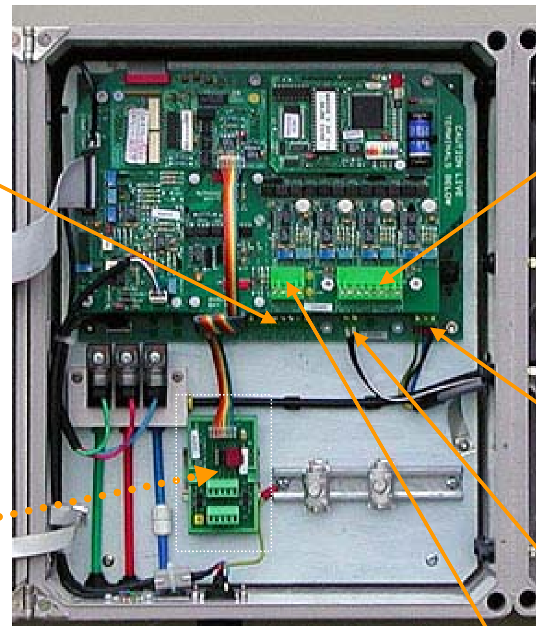
The digital I/O is powered internally by the instrument. It has been observed that some Consulting Engineers have specified surge arrestors in the cabling associated with the Local Control Box.

The power supply design of these instruments is such that the "Common" digital I/O supply line is (NEGATIVE or MINUS) 24VDC with respect to the system 0V and each digital output is individually held to 0V when the output is active.

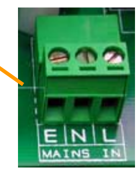
THIS SHOULD BE TAKEN INTO ACCOUNT WHEN SPECIFYING ANY ANCILLARY EQUIPMENT TO BE ATTACHED TO THIS INSTRUMENT, NOT EXPLICITLY SPECIFIED IN THIS MANUAL.

Figure 21 - 5.7.3. (i) Terminal Designations for single DO instrument (With & without optional Comms)

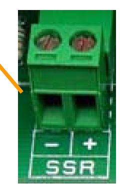
Main I/O Terminal	Function	Comments
RL0 NC	Alarm 1 - normally closed	Volt-free contacts
RL0 COM	Alarm 1 - common	Volt-free contacts
RL0 NO	Alarm 1 - normally open	Volt-free contacts
RL1 NC	Alarm 2 - normally closed	Volt-free contacts
RL1 COM	Alarm 2 - common	Volt-free contacts
RL1 NO	Alarm 2 - normally open	Volt-free contacts
RL2 NC	Alarm 3 - normally closed	Volt-free contacts
RL2 COM	Alarm 3 - common	Volt-free contacts
RL2 NO	Alarm 3 - normally open	Volt-free contacts
RL3 NC	Alarm 4 - normally closed	Volt-free contacts
RL3 COM	Alarm 4 - common	Volt-free contacts
RL3 NO	Alarm 4 - normally open	Volt-free contacts



Terminal	Function
Analogue Output – 0 +	Analogue Output 1 +ve
Analogue Output – 0 -	Analogue Output 1 -ve
Analogue Output – 1 +	Analogue Output 2 +ve
Analogue Output – 1 -	Analogue Output 2 -ve
Analogue Output – 2 +	Analogue Output 3 +ve
Analogue Output – 2 -	Analogue Output 3 -ve
Analogue Output – 3 +	Analogue Output 4 +ve
Analogue Output – 3 -	Analogue Output 4 -ve

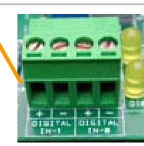


Terminal	Function
Mains in E	Mains (Line) supply Earth
Mains in N	Mains (Line) supply Neutral
Mains in L	Mains (Line) supply Live



Terminal	Function
SSR + & SSR -	Compressor supply control

(These terminals are Pre-wired on units with integral compressor)



Terminal	Function
Dig in – 0+	Calibration request +24V
Dig in – 0-	Calibration request 0V
Dig in – 1+	Uncommitted
Dig in – 1-	Uncommitted

With optional COMMS

CN1 and CN2 are provided to accept incoming and outgoing multidrop communications cable wire tails to avoid the practice of wiring two tails into one terminal.

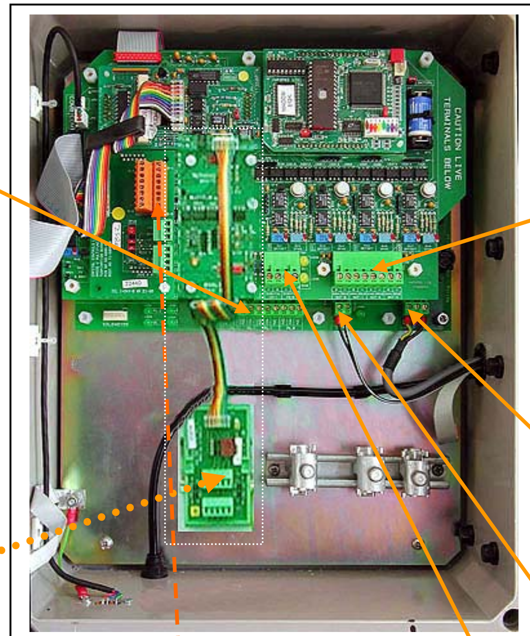
The terminals are electrically connected by function to their corresponding 'partners'.

Comms I/O Terminal	Function
CN1 Tx-	RS422 transmit -ve
CN1 Tx+	RS422 transmit +ve
CN1 Rx-	RS422 receive -ve
CN1 Rx+	RS422 receive +ve
CN1 0V	RS422 signal grnd
CN2 Tx-	RS422 transmit -ve
CN2 Tx+	RS422 transmit +ve
CN2 Rx-	RS422 receive -ve
CN2 Rx+	RS422 receive +ve
CN2 0V	RS422 signal grnd

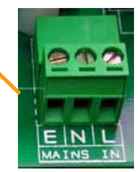
[Spacer page]

Figure 22 - 5.7.3. (ii) Terminal designations for single DO with a Local Control Box (shown overleaf)

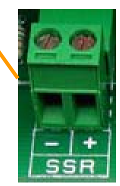
Main I/O Terminal	Function	Comments
RL0 NC	Alarm 1 – normally closed	Volt-free contacts
RL0 COM	Alarm 1 – common	Volt-free contacts
RL0 NO	Alarm 1 – normally open	Volt-free contacts
RL1 NC	Alarm 2 – normally closed	Volt-free contacts
RL1 COM	Alarm 2 – common	Volt-free contacts
RL1 NO	Alarm 2 – normally open	Volt-free contacts
RL2 NC	Alarm 3 – normally closed	Volt-free contacts
RL2 COM	Alarm 3 – common	Volt-free contacts
RL2 NO	Alarm 3 – normally open	Volt-free contacts
RL3 NC	Alarm 4 – normally closed	Volt-free contacts
RL3 COM	Alarm 4 – common	Volt-free contacts
RL3 NO	Alarm 4 – normally open	Volt-free contacts



Terminal	Function
Analogue Output – 0 +	Analogue Output 1 +ve
Analogue Output – 0 -	Analogue Output 1 -ve
Analogue Output – 1 +	Analogue Output 2 +ve
Analogue Output – 1 -	Analogue Output 2 -ve
Analogue Output – 2 +	Analogue Output 3 +ve
Analogue Output – 2 -	Analogue Output 3 -ve
Analogue Output – 3 +	Analogue Output 4 +ve
Analogue Output – 3 -	Analogue Output 4 -ve

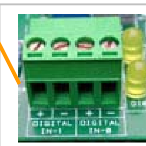


Terminal	Function
Mains in E	Mains (Line) supply Earth
Mains in N	Mains (Line) supply Neutral
Mains in L	Mains (Line) supply Live



Main I/O Terminal	LCB Terminal	Function
SSR +	N/C	Compr. supply control
SSR -	T11*	Compr. supply control

(* Shares terminal with wiring to integral compressor)



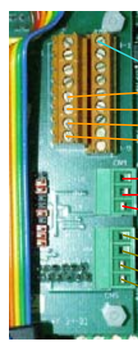
Terminal	Function
Dig in – 0+	Calib request +24V
Dig in – 0-	Calib request 0V
Dig in – 1+	Uncommitted
Dig in – 1-	Uncommitted

With optional COMMS

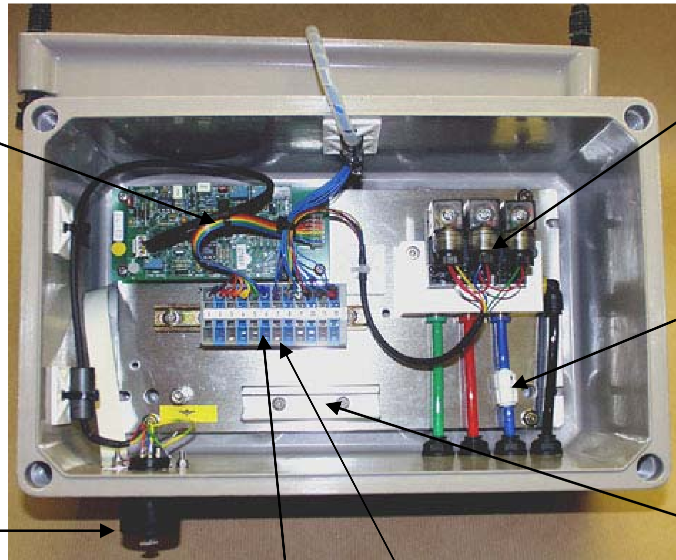
CN1 and CN2 are provided to accept incoming and outgoing multidrop communications cable wire tails to avoid the practice of wiring two tails into one terminal.

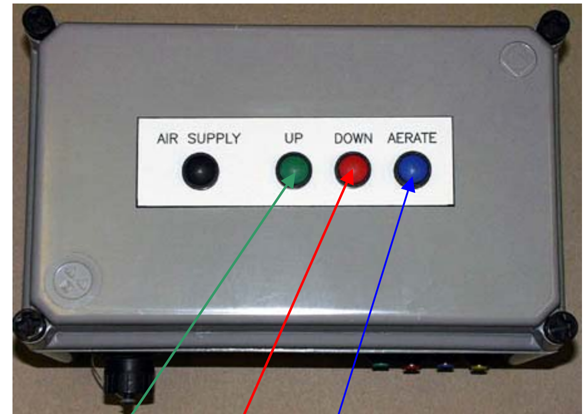
The terminals are electrically connected by function to their corresponding 'partners'.

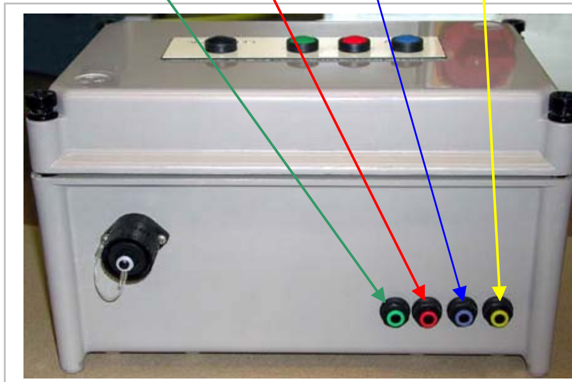
Comms I/O Terminal	Function
CN1 Tx-	RS422 transmit -ve
CN1 Tx+	RS422 transmit +ve
CN1 Rx-	RS422 receive -ve
CN1 Rx+	RS422 receive +ve
CN1 0V	RS422 signal grnd
CN2 Tx-	RS422 transmit -ve
CN2 Tx+	RS422 transmit +ve
CN2 Rx-	RS422 receive -ve
CN2 Rx+	RS422 receive +ve
CN2 0V	RS422 signal grnd

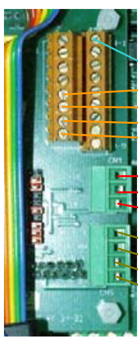


Multifunction I/O terminal	LCB Terminal	Function
TB1 – 1B	T10	Digital supply common
TB1 – 5A	T9	Aerate
TB1 – 6A	T7	Down
TB1 – 7A	T8	Up
TB1 – 8A	T12	LCB Buttons enable
CN4 -- +ve	T1	Head amp supply +15V
CN4 – 0V	T2	Head amp supply 0V
CN4 -- -ve	T3	Head amp supply -15V
CN5 – SigA +	T4	DO signal +
CN5 – Sig 0V	T5	Signal common
CN5 – SigB +	T6	Temperature signal +
CN5 – Sig 0V	--	No connection









Multifunction I/O terminal
TB1 – 1B
TB1 – 5A
TB1 – 6A
TB1 – 7A
TB1 – 8A
CN4 -- +ve
CN4 – 0V
CN4 -- -ve
CN5 – SigA +
CN5 – Sig 0V
CN5 – SigB +
CN5 – Sig 0V

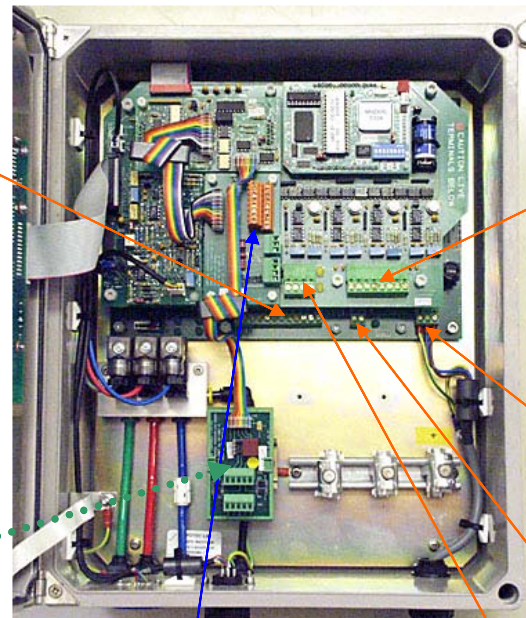
LCB Terminal	Function
T10	Digital supply common
T9	Aerate
T7	Down
T8	Up
T12	LCB Buttons enable
T1	Head amp supply +15V
T2	Head amp supply 0V
T3	Head amp supply -15V
T4	DO signal +
T5	Signal common
T6	Temperature signal +
T11	Compressor on

Motherboard Main
I/O terminal

SSR-

Figure 23 - 5.7.3. (iii) Terminal Designations for double DO instrument with LCB shown overleaf

Main I/O Terminal	Function	Comments
RL0 NC	Alarm 1 – normally closed	Volt-free contacts
RL0 COM	Alarm 1 – common	Volt-free contacts
RL0 NO	Alarm 1 – normally open	Volt-free contacts
RL1 NC	Alarm 2 – normally closed	Volt-free contacts
RL1 COM	Alarm 2 – common	Volt-free contacts
RL1 NO	Alarm 2 – normally open	Volt-free contacts
RL2 NC	Alarm 3 – normally closed	Volt-free contacts
RL2 COM	Alarm 3 – common	Volt-free contacts
RL2 NO	Alarm 3 – normally open	Volt-free contacts
RL3 NC	Alarm 4 – normally closed	Volt-free contacts
RL3 COM	Alarm 4 – common	Volt-free contacts
RL3 NO	Alarm 4 – normally open	Volt-free contacts

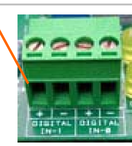


Terminal	Function
Analogue Output – 0 +	Analogue output 1 +ve
Analogue Output – 0 -	Analogue output 1 -ve
Analogue Output – 1 +	Analogue output 2 +ve
Analogue Output – 1 -	Analogue output 2 -ve
Analogue Output – 2 +	Analogue output 3 +ve
Analogue Output – 2 -	Analogue output 3 -ve
Analogue Output – 3 +	Analogue output 4 +ve
Analogue Output – 3 -	Analogue output 4 -ve

Terminal	Function
Mains in E	Mains (Line) supply Earth
Mains in N	Mains (Line) supply Neutral
Mains in L	Mains (Line) supply Live

Main I/O Terminal	LCB Terminal	Function
SSR +		Compressor supply control
SSR -	T11*	Compressor supply control

(* Shares terminal with wiring to integral compressor)



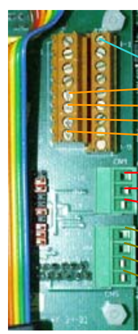
Terminal	Function
Dig in – 0+	Head 1 Calib request +24V
Dig in – 0-	Head 1 Calib request 0V
Dig in – 1+	Head 2 Calib request +24V
Dig in – 1-	Head 2 Calib request 0V

With optional COMMS

CN1 and CN2 are provided to accept incoming and outgoing multidrop communications cable wire tails to avoid the practice of wiring two tails into one terminal.

The terminals are electrically connected by function to their corresponding 'partners'.

Comms I/O Terminal	Function
CN1 Tx-	RS422 transmit -ve
CN1 Tx+	RS422 transmit +ve
CN1 Rx-	RS422 receive -ve
CN1 Rx+	RS422 receive +ve
CN1 0V	RS422 signal grnd
CN2 Tx-	RS422 transmit -ve
CN2 Tx+	RS422 transmit +ve
CN2 Rx-	RS422 receive -ve
CN2 Rx+	RS422 receive +ve
CN2 0V	RS422 signal grnd



Multifunction I/O terminal

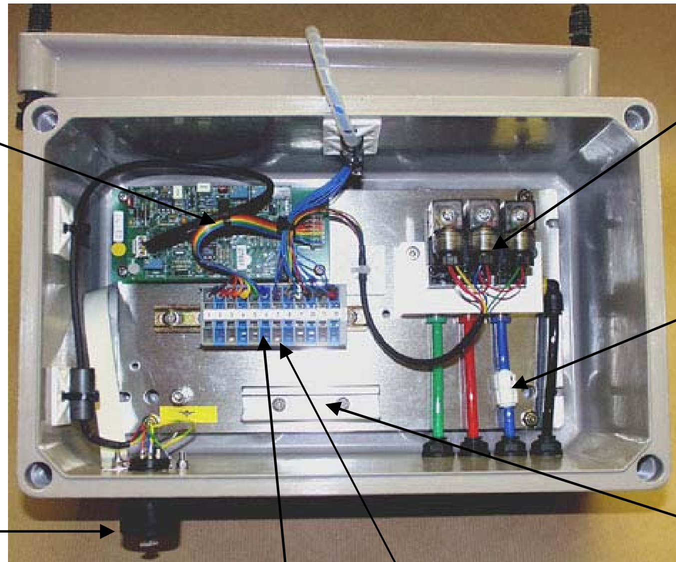
TB1 – 1B
TB1 – 5A
TB1 – 6A
TB1 – 7A
TB1 – 8A

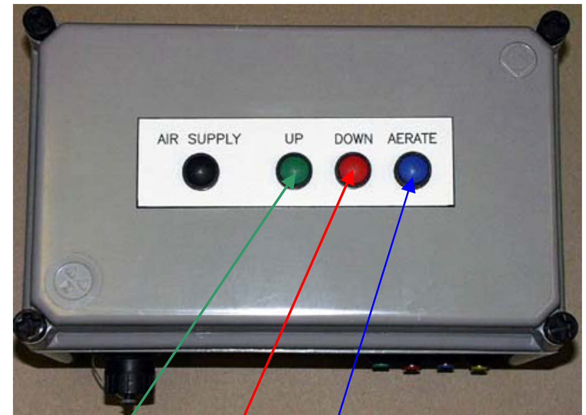
CN4 -- +ve
CN4 – 0V
CN4 -- -ve

CN5 – SigA +
CN5 – Sig 0V
CN5 – SigB +
CN5 – Sig 0V

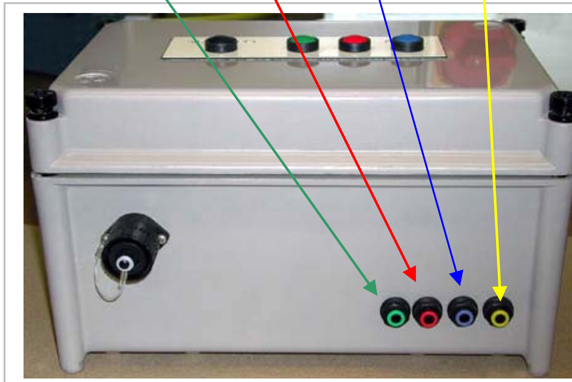
LCB Terminal	Function
T10	Digital supply common
T9	Aerate
T7	Down
T8	Up
T12	LCB Buttons enable
T1	Head amp supply +15V
T2	Head amp supply 0V
T3	Head amp supply -15V
T4	DO signal +
T5	Signal common
T6	Temperature signal +
--	No connection

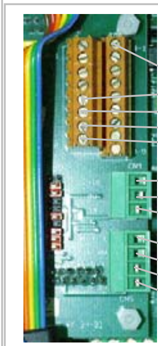
SEVERN TRENT SERVICES



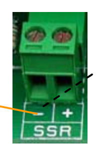


UP (Green) DOWN (Red) AERATE (Blue) AIR (from main assembly)





Multifunction I/O terminal	LCB Terminal	Function
TB1 – 1B	T10	Digital supply common
TB1 – 5A	T9	Aerate
TB1 – 6A	T7	Down
TB1 – 7A	T8	Up
TB1 – 8A	T12	LCB Buttons enable
CN4 -- +ve	T1	Head amp supply +15V
CN4 – 0V	T2	Head amp supply 0V
CN4 -- -ve	T3	Head amp supply -15V
CN5 – SigA +	T4	DO signal +
CN5 – Sig 0V	T5	Signal common
CN5 – SigB +	T6	Temperature signal +
CN5 – Sig 0V		
	T11	Compressor on



Motherboard Main I/O terminal

SSR-

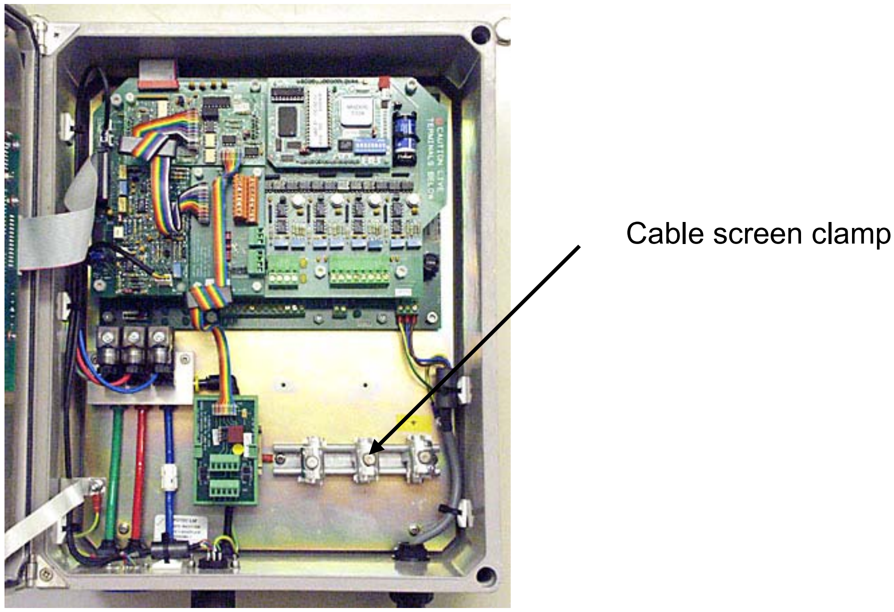


Figure 24 - Signal cable(s) screen termination detail

☞ **Signal cable screens must be clamped using the fitting supplied**

5.7.3 Sensor cable connection

The sensor cable connections are made into the main electronics module or the local control box as appropriate. The connection is by means of a pre-wired multi pole connector. The plug merely needs inserting into its mating socket and the retaining ring tightening up to prevent moisture ingress.

5.8 Pneumatics Connections

Connect the three pneumatic tubes between the Main System Assembly and the DO Probe Assembly. These are normally colour coded red, blue and green. Connection is achieved using push fit connectors. Please refer to the details given in Section 3.5 and Section 4 Technical Specification.

Pneumatic through-connectors are provided to allow ease of connection and disconnection of the DO probe pneumatic lines from the Main System Assembly.

If a local control box is to be installed, an extra push fit connector may be fitted to the bottom of the front panel interface box (see section 5.7.2). This is used to provide an air supply to the local control box. The air line should be 6mm nylon tube to BS5409 standard, colour black. Alternatively, site air may be used to supply the system independently.

[Section Spacing Page]

6 COMMISSIONING PROCEDURE

6.1 Pre-commissioning checks

Following installation, the ***AZTEC DO System*** should be visually inspected for signs of mechanical damage incurred during installation. Where damage is found **Severn Trent Services** should be notified for advice on whether to proceed with the commissioning phase. The following pre-commission checks must be carried out BEFORE the local isolator is placed in the ON position. Check and correct as necessary:

a) The mounting of the Main System Assembly is sound.

b) The power supply rating of ***AZTEC DO System*** is the same as the power supply provided.

c) Power supply terminations are secure, safe and in good condition.

d) Supplementary and equipotential bonding conductors are securely terminated and in good condition.

e) Protective shrouding and covers are secured in place and in good condition.

f) All fuses are sound, of the correct rating and in place. (See table or diagrams on the following page).

g) The DO cell is fitted to the DO Probe Assembly before it is immersed in the tank.

h) The signal cable from the DO Probe Assembly is connected into the Main System Assembly.

i) The three, pneumatic tubes from the DO Probe Assembly are connected to the corresponding pneumatic lines from the Main System Assembly.

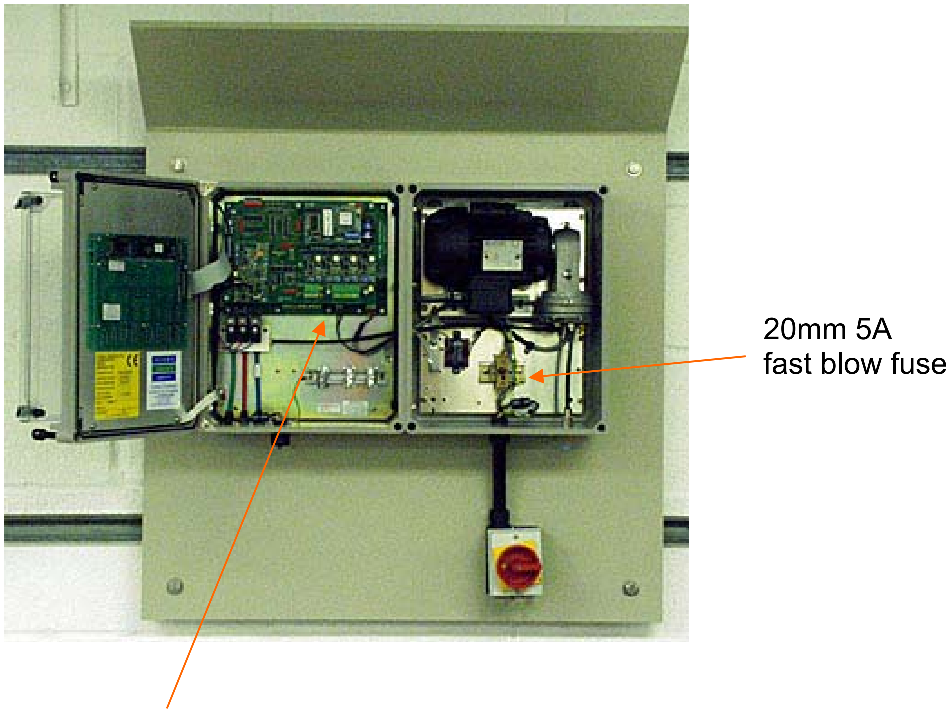
j) If a Local Control Box is included ensure that the air supply is connected to the black connector. This may be from the Main System Assembly if it contains its own compressor, or from a site air supply.

k) The positions of the DIP (DIL) switches on the Proteus module in the main electronics enclosure at the top right of the PCBs – refer to the section on serial communications, DIP command

l) Verify the DIP (DIL) switch positions (See Page 191). These will have been set in the factory. If changed accidentally, a cold restart will be necessary.

The items detailed in (a) to (l) above must be verified as being satisfactory before proceeding beyond this point.

Fuse ratings and positions



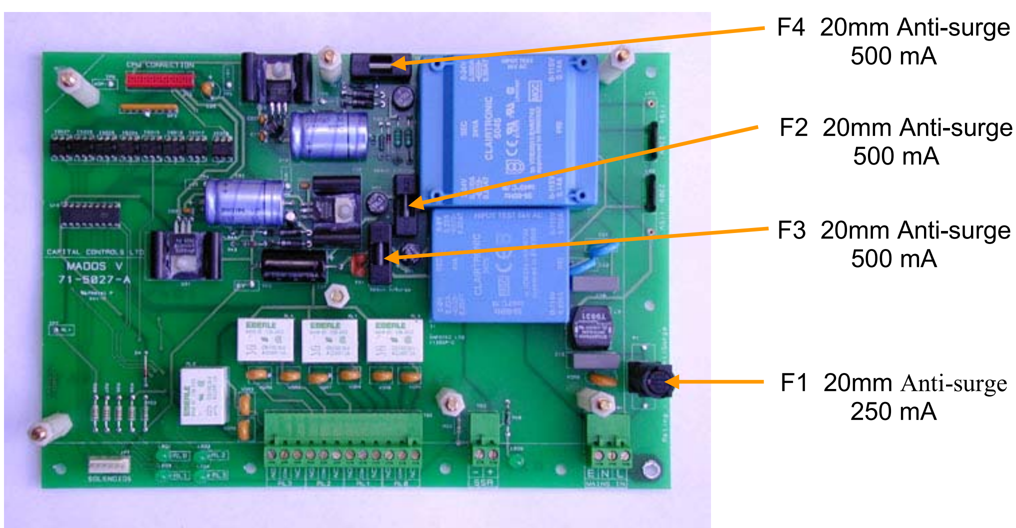


Figure 25 - Fuse ratings and location

6.2 Power up

It is necessary for the instrument to know the correct date and time before logging will occur. It also needs to know when it has a new DO sensor cell or cells installed. If the instrument has not been powered up before, it will do this automatically by performing a **cold start**. If it has been powered up before, it will perform a warm start. It will remember the set date and time but will need to be told if a new DO cartridge has been installed.

The procedure for both these situations is given below:

Cold Start

Clock Setting: On power up the following display requesting the user to set the clock will appear on the front panel

```
Power up           Cold start
```

Followed by:

```
Please set clock
```

Press '1' then '2' then '3' then '4' using the keypad on the front panel

The following menu will be displayed:

```
1.Clock   2. Manual  3. Probe  4. Quit
Use YES/NO or Num then ENT to select
```

Press '1' followed by 'ENT'

The following will be displayed:

```
 = = =  Clock Menu = = =
28/01/2003   15:06:23
```

Position the flashing cursor on the right hand side of the number to be changed. The cursor is moved to the right by pressing 'YES' and to the left by pressing 'NO'.

Note:

In all AZTEC instruments the date is in the United Kingdom format DD/MM/YY and the time is in 24-hour format HH:MM:SS. This format is hard-coded into the instrument's software and cannot be changed.

Press 'ENT'
Key in the Day (the day number within the month)
Press 'ENT'

Move the cursor to the next value to be changed and repeat the above for the month, year, hours and minutes until all the date and time fields have been set.

Press 'DEL'
Press 'YES' to update the clock

Press 'YES' to display the date and time on the LCD.
Press 'DEL' to return to the main display.

The instrument will now automatically carry out an autocalibration.

Warm Start:

If the following message is shown on power up

```
Power up          Warm Start
```

then the instrument has been powered up previously since leaving the factory and may have some appropriate sensor characteristics, logged data and user-settings stored in its memory that you wish to keep. In that case the following procedure should be adopted:

Press '9999' (i.e. '9' four times in succession)

A safety message will be displayed:

```
SAFETY:  Please disconnect all air
lines before handling the probe.  OK?
```

Press 'YES' followed by 'ENT'

```
Suspend normal operation?
```

Press 'YES'. If the instrument is a double DO you will be asked to select the sensor head. On a double-DO instrument head 1 is by the main panel; head 2 is by the Local Control Box.

Press '1' followed by ENT.

Now press 'DEL'. The following screen will be displayed:

```
1.Autocal  2.  Newcart  3. ZDO  4.Quit
Use YES/NO or Num then ENT to select
```

Press '1' followed by 'ENT':

```
Trigger autocal?
```

Press 'YES'. Now press 2 followed by 'ENT'.

```
Does the carriage have a new span?
```

Press 'YES' followed by 'DEL'

```
Resume normal operation?
```

If the instrument is a single-DO, then press 'YES'; if the instrument is a double-DO then press 'NO' and you will be returned to the screen asking you to select a sensor head. This time press '2' followed by 'ENT' and repeat the above sequence, then when asked to resume normal operation press 'YES'.

The above procedure will ensure that the instrument recognises that it has a new cartridge (or cartridges if double DO.) and will automatically carry out calibrations on the head (or heads if double DO).

Even on warm starts one should check that the clock has been set correctly by carrying out the clock set procedures as previously described. The instrument will not log data until the clock has been set, and if set incorrectly will log data against the wrong data or time. The software will check the entered date and time and will reject any attempt to enter an illegal date and/or time.

When the instrument has completed its calibrations it should display either one or two "=" signs on the right hand side of the display depending on how many sensors it has. This will indicate that the calibration has been successful.

Please note that until this procedure has been completed any alarm signals or analogue output signals will be invalid, and data will not be logged correctly. It is important therefore, that any controls affected by alarm or analogue output signals are disabled until the initial calibration cycle has completed successfully.

☞ The AZTEC DO System is now basically operational, but will probably need further configuration to tailor it to individual requirements and preferences.

It is now time to configure the analogue and alarm outputs to tailor them to suit individual requirements. This is done by the outputs setup menu accessed by default by keying in ‘8888’ on the keypad. Details of the procedure are given in section 8.

If you wish to enter corrections for altitude, depth of immersion, salinity or barometric pressure, please refer to sections 8.8 through to 8.11.

7 OPERATION

The ***AZTEC DO System*** is a self-contained modular system that provides reliable and accurate measurement of dissolved oxygen (DO) concentration.

The system provides sufficient information to allow the operator to assess when the probe is healthy and when the probe is in need of attention.

The processor unit located in the Electronics Module executes software that:

- Sequentially controls the equipment involved in the DO autocalibration and clean/exercise cycles
- Processes sensor signals to provide the following measurements:
    - RAW DO
    - AUTOCAL DO
    - AUTOCAL-HELD DO
    - TEMPERATURE
- Provides detection of alarm states
- Outputs analogue values though assigned analogue output ports appropriate to the corresponding designated analogue output parameters.
- Enables detection of cell malfunctions
- Provides the maintainer with prompts, display of measured values and an operation override

The first four actions are carried out invisibly to the user by the software program running automatically and continuously. The last action is carried out via the Front Panel Interface keypad.

At any particular time the ***AZTEC DO System*** can be in one of three operational states:

7.1 Normal mode of operation
7.2 DO Autocalibration / Clean cycle
7.3 Front Panel Operation (Local Mode)

The instrument normally spends the vast majority of its time in the **normal mode** of operation.

The three operational states are described in more detail as follows:

7.1 Normal mode of operation

During the normal mode of operation, the ***AZTEC DO System*** measures and generates a number of different parameters. These parameters and their values may be observed on the display of the front panel interface. The user may scroll through the displayable parameters via the keypad 'YES' and 'NO' keys.

During the normal mode of operation of a DO instrument, or the DO part of a DO-MLSS combination instrument, the software running on the processor unit continuously loops reading in the **two** primary DO/temperature physical sensor signals:

1. 'd.o input'

This signal is derived from the DO cell after it has been fed through the associated DO head amplifier. The parameter reflecting the output of this amplifier is scaled in volts DC. (Note the sensor itself gives out a small (just a few microamperes) current signal proportional to the partial pressure of the oxygen in the medium surrounding the cell. This signal has to be converted to a voltage to be processed by the main electronics hardware and software.

2. 'raw temp'

This is the non-linearised signal from the thermistor in the DO cell holder. (Note the sensor itself has a resistance that varies with temperature. This resistance has to be converted to a voltage to be processed by the main electronics hardware. The software corrects for the fact the resistance of the thermistor does not vary linearly with temperature.

From these two signals **all** the other signals are generated as follows:

3. 'raw sat d.o'

This is a scaled derivative of "d.o input" representing the value of percentage DO saturation which is span-adjusted so that 100 % saturation read 100% only at the time that the processor unit has been told that a "new" DO measuring cell has been fitted and only after it has calibrated successfully. The range of this measurement is by default to 0 – 130 % saturation, but it can be changed by the user.

4. 'temperature'

This is the linearised and scaled derivative of "raw temp". A look-up table is applied to correct the non-linear characteristics of the thermistor (RTD) used in the measuring cell holder. This signal is scaled 0 – 50 °Celsius.

5. **'autocal d.o'**

This is a scaled, span-adjusted derivative of "d.o input", representing the value of DO saturation which, unlike "raw sat d.o", is span-adjusted every time a successful calibration has been completed by the processor unit.

Following a successful "new" calibration, "raw sat d.o" and "autocal d.o" will be identical initially. Following subsequent successful calibrations, only "autocal d.o" is adjusted. Comparing the changing ratio between "raw sat d.o" and "autocal d.o" can provide a useful diagnostic for monitoring the varying performance of the DO measuring cell over time. As with "raw sat d.o" the "autocal d.o" parameter is, by default, scaled 0 - 130% saturation but can be changed by the user.

6. **'a.cal held d.o'**

This is a 'clone' of "autocal DO" except that during calibration the value is held at that calculated immediately prior to calibration and released following a short settling time after calibration. This could be used as the output to a control system to minimise disturbances during calibration – the system would be fed a constant signal proportional to the last real measured value (an average reading taken just before the instrument entered calibration mode) while the sensor was calibrating. This parameter too is scaled by default to 0 -130% sat.

7. **'absolute d.o'**

This is the scaled, temperature-compensated version of "autocal d.o". It is scaled, by default, 0 –10 mg/l but may be changed by the user.

8. **'abs held d.o'**

This is a scaled, temperature-compensated version of "autocal d.o". It is scaled by default to 0 -10mg/l but may be changed by the user. This is the signal most commonly used for control purposes.

9. **'DO at calib'**

This parameter indicates the percentage saturation reached by the DO measuring cell immediately prior to span adjustment during a calibration cycle. Used as a diagnostic, this parameter can help determine the continued consistent performance of the system when at or near a value of 100% over a period.

Large deviations in the value 'DO at calib' may indicate, for instance, a sustained fouling which has overwhelmed the cleaning system or a deteriorating measuring cell at the end of its useful life.

10. 'q cal a.fact'

This parameter is used to record the span adjustment factor calculated by the software and applied to the autocal parameters following "quick" or "short" autocalibration.

The default autocalibration method is a 'long' autocalibration and is recommended, but quick calibrations may be useful in certain special situations. The user can invoke quick autocalibrations as their preferred method of autocalibrating.

A quick autocalibration can be completed in approximately 6 minutes, but if quick calibrations are selected, a long autocalibration (approximately 30 minutes) will be initiated should a fixed number - 5 by default, but adjustable by the user - of quick calibrations in a row are rejected as unsuccessful.

Quick calibrations can be useful in situations where there is a large difference in process liquor temperature and calibration air temperature. In extremes, this can complicate calibration because of thermal lag and temperature differences between the DO sensor and the thermistor that is supposed to be reflecting the temperature affecting the DO sensor output.

Long calibrations are the recommended norm. A quick calibration is a compromise. When a change is made to set quick calibrations as the default, a long calibration is always performed once initially. The software records the difference in behaviour of the DO cell between the truncated response of the cell in the quick calibration period and the full, stabilised response that is assured by the time allowed by aerating for the full period decreed in the long calibration. The software then assumes that in subsequent quick calibrations the characteristics of the DO cell would have remained the same – that had it been allowed to go on to perform its full calibration, the response difference would be the same as in the initial long calibration.

For a quick calibration to work, the DO cell MUST be in good condition, clean and responsive. An ageing DO cell will not give good quick calibrations.

A quick calibration is in effect a deliberately truncated long calibration. When an instrument performs a long calibration, details are logged of the early period that would correspond to the timings for a quick calibration and then it continues for the full period of the long calibration. It is possible to examine the logged statistics of the comparative performance of the quick and long calibration periods of a long calibration and so confirm whether a quick calibration would give acceptable stability and accuracy of calibration.

11. 'I cal a.fact'

This parameter is used to record the span adjustment factor calculated by the software and applied to the 'autocal' parameters following long calibration, which is the default calibration type.

Also see the notes in (10) above. It can be instructive to compare for relative reproducibility the 'I cal a.fact' and the 'q cal a.fact' that is also recorded when long calibrations are used. The comparative statistics can help to decide whether it would be feasible to use quick rather than long calibrations in special circumstances.

12. 'DO cal. fails'

This is calculated by the software from the number of successive calibration failures – i.e. calibrations that have been rejected by the statistical checks made by the software because they fail to meet the criteria, either the default criteria or those reconfigured by the user.

This parameter's value becomes zero whenever a calibration succeeds, then increments with successive calibration failures, and goes back to zero on a successful calibration. When this parameter is retrieved from the instrument and examined graphically with the software it provides a highly visual method of indicating circumstances where conditions within the process may be at their most demanding for the measurement system, or when complete failure of the autocalibration has occurred, either for environmental (fouling) or for physical (lack of air, failure of sensor, failure of equipment) reasons.

This parameter can be useful when assigned to alarm output or as part of a set of grouped alarm outputs to indicate the general 'health' of the instrument.

Each time all the parameters measurable or calculable by the software in the instrument have been generated they are checked against the alarm settings and the appropriate alarms activated. The software loops rapidly and continuously updating its readings from the sensors; making new calculations; setting or clearing alarms; and changing analogue outputs appropriately.

Any of the measured or calculated parameters can be directed to any of the four analogue outputs. They can be freely assigned by the user – see *Section 9 Serial Communications.*

7.2 DO Autocalibration / Clean Cycle

7.2.1 Autocalibration Cycle

The autocalibration cycle is normally executed automatically once a day during a non-critical period on, or close to, a preset base time. The user can reconfigure the autocalibration frequency, or can manually trigger an autocalibration at any time from the front panel via the menu system.

The processor unit takes a number of actions when an autocalibration cycle is initiated either automatically or manually.

At predetermined time intervals for predetermined durations throughout an autocalibration cycle, the processor unit activates outputs that trigger power transistors to open or close the relevant pneumatic valve(s) and a solid state relay that turns the integral compressor (if fitted) on or off.

Initiation of an autocalibration cycle

The autocalibration cycle is initiated:

- Automatically during normal operation - by default once per day unless overridden by the user

- On a power up cold start (where memory contents have been lost or the instrument has not been initially fully set up)

- On a power up, warm start (where memory contents have previously been initialised and retained), and the calibrate on power up flag is set to say the instrument is to recalibrate in the event of a warm restart

- Via the keypad, through the maintenance menu

- By contact closure of the 'Calibration Request' digital input

- On request via serial communications commands

- Four hours after a failed routine daily autocalibration, unless overridden by the user

Fundamental autocalibration steps

All autocalibration sequences are fundamentally the same except for the final action taken if the system has just cold started or has been told it has a new cell.

The timings described below apply to the recommended default long calibration. The basic principles are the same for a short (quick) calibration, but the timings differ and the autocalibration calculations differ, the cell response being extrapolated to predict its expected response had it been allowed the full (long) stabilisation time.

There are **six** control steps involved in a normal default long autocalibration cycle:

1. **Control signals are held** - i.e. parameter 'a.cal held d.o' stays constant and in DO-MLSS systems the held MLSS signals are held too.

2. **Air scour/brush cleaning of cell - Piston exercised (brush cleaned)**

   At the start of autocalibration the DO cell, and MLSS sensor in DO-MLSS instruments, is scoured with air and wiped with the brush assembly by compressed air operation of the pneumatic cylinder. This removes light organic growth.

3. **Exposure of the cell to air for calibration**

   To expose the cell to air, the main sensor assembly must be drawn inside the wet end assembly by compressed air operation of the pneumatic cylinder.

   The aerate valve is maintained in the open position and the area local to the cell (inside the wet end assembly) is filled with air. At this point, any liquid inside the wet end assembly is expelled. This will take approximately 5 seconds. The aerate valve is left in the open position so air constantly blows down to the sensor, which is now in an air environment.

4. **Automatic adjustment of DO cell signal span**

   The cleaned DO cell (and MLSS sensor in combined DO-MLSS instruments) assembly is exposed to air for approximately 30 minutes by default for a long calibration. This normally allows the cell enough time for its response to thoroughly stabilise.

   Approximately 25 minutes after the start of the autocalibration cycle the AUTOCAL factor is calculated and an automatic adjustment of the DO AUTOCAL signal span is made provided that the calibration was acceptable (passed all the criteria and checks imposed by the software).

The assembly is then left exposed to calibrating air for a further 2 minutes. This extra period is to allow easy visual inspection of any change made to DO signal span by the software if the detailed logged calibration data is retrieved using the data retrieval and inspection software.

5. Returning the assembly to the normal measurement position

The calibration air is turned off and the assembly is returned to its normal measurement position in contact with the process liquor to be measured.

6. Termination of the autocalibration cycle.

The DO cell is then finally allowed to stabilise for a further approximately 3 minutes whilst in direct contact with the process liquor. This is to allow the cell output time to respond and reflect the DO of the medium in which it now finds itself. During this time, the HELD autocal DO signal (and held MLSS signal if a DO-MLSS instrument) remains held. After this stabilisation period the AUTOCAL-HELD signal is released, and will follow the AUTOCAL signal. It is no longer held, and will vary in real-time in line with the varying process DO. The held MLSS signal, if a DO-MLSS instrument, is also fully released at this time.

The autocalibration cycle is now complete and normal mode of operation resumes.

In the case of a quick DO calibration, the procedure above is followed but the timings are changed and the way the autocal factor is calculated changes. For further information refer to the notes on ‘q cal. a fact’ and in section 7.1 (10) and ‘q cal. a fact’ 7.1 (11) under “Normal mode of operation” for the differences between quick versus long DO autocalibrations.

7.2.2. Cleaning Cycle

Cleaning of the DO cell (and MLSS sensor if a DO-MLSS combined instrument) always takes place at the beginning of a DO autocalibration, but also more frequently as an independent short process. The frequency of cleaning is user-reconfigurable but defaults to once every 4 hours. The cleaning cycle consists of steps (1), (2), (5) and (6) of the autocalibration cycle – namely:

- Control signals are held
- Air scour/brush cleaning of sensors takes place
- The sensor is returned to the process measurement position, extended from the shroud
- The system is allowed to stabilise (3 minutes) to the new readings before the held signals are released and allowed once more to follow real-time process variations.

7.3 Front Panel Operation (Local Mode)

A keypad and display, located inside the Electronics Module, is provided for the local user to access a number of system facilities, full details of which are contained in *Section 8 - Using the front panel interface.*

Unscrewing two black plastic retention screws and opening the clear front cover of the module outwards to the left gives access to the membrane keypad. Its layout is shown in the photograph below.

Electronics module   Parameter display   Keypad controls

Figure 26 – Electronics module – Front Panel display and keypad

Local Control Box (if applicable)

A local control box is installed adjacent to a remote AZTEC DO probe location. It is provided to house the sensor amplifier and pneumatics and allows for manual testing of cleaning and aerating functions. The layout is shown below:

View from front

View from bottom

Figure 27 - Local Control Box showing layout.

8 USING THE FRONT PANEL INTERFACE

8.1 General Description

A keypad and display located in the Electronics module provided access to many of the facilities available to the user.

Figure 28 - Front Panel Interface Electronics Module (Display and keypad)

It is possible to check the current state of the instrument and configure, test and alter its operation.

This part of the manual describes how information may be observed and parameters altered using the front panel keypad and display.

When in normal operation the MAIN SCREEN is displayed – something similar to that shown below:

```
'MSL_DO'  DATE=08/09/94 TIME = 15:05:20 =
temperature                    10.2 deg C
```

This represents a typical example of the MAIN SCREEN from an AZTEC DO System. The screen consists of three main areas:

```
(A)  Clock Display line                 (C)*
(B)  Parameter Display line             (D)
```

Alarm active * symbol

(C) is the autocalibration status for the first, or only head.
(D) is the autocalibration status for a second head (if present).

(A) **Clock Display/Status line:** The current date and time settings of the instrument are shown unless the instrument has been reconfigured to not display the current date and time. The date and time may be altered using the general setup menu described later. By default the top line also shows action strings – short routine messages generated to show when something happens to change what the instrument is doing from time to time. The user is able to forcibly view the current (latest) action string by pressing '.' (dot / stop / period) on the front keypad even when it is not currently shown.

(B) **Parameter Display:** This section displays the current readings measured by the system. By pressing the '**ENT'** or '**DEL'** keys, the user may scroll through the displayable parameters. The current data for a single parameter is displayed on the second line of the display unless the instrument has been reconfigured to not display the current date and time. In that case, one parameter would be displayed on the first line and the next on the second line. Other parameters can be displayed using the '**YES**' and '**NO**' keys to scroll through the displayable parameters.

(C/D) Autocalibration Status: In the case of the DO System this display indicates whether the last calibration was successful, and can be one of the following symbols:

‘=’ shows that an instrument has accepted its last calibration.

‘N’ shows a NEW calibration is in progress.

‘?’ indicates a failed calibration and may also show a lower case letter, “a” – “f”, “a” meaning one fail, “b” meaning two consecutive fails. “c” three consecutive fails, and so on).

If an ‘X’ is displayed, it means that software has been unable to detect a DO head – check if one is connected or the cable or connection is faulty.

At cold start-up a ‘N’ or ‘?’ symbol will always be displayed until a good calibration is made.

Please note that the symbols described above are designed to be displayed to provide a quick assessment of the instruments state. A **“?”** being displayed does **NOT** mean the instrument is not working; it indicates that the instrument is having to use a previous **good** set of calibration information, which in most cases is fine, but the instrument may need attention. The use of the **‘a’…** symbols is to assess if fails are becoming cumulative – which is a prompt that investigation is required. The default is to show a **“?”** after six fails in a row.

The ***alarm active*** **‘*’** symbol is a diagnostic flag (Please see the part of the manual describing the ‘8888’ menu).

8.2 Menus Available via the Main Screen

User menus may be accessed from the MAIN SCREEN. The requirement to type in one of a number of special 4-digit passnumbers prevents unauthorised entry by casual users. There is no indication on the display of a passnumber being typed. If a mistake is made when entering a passnumber, then press one of the four **non-numeric** keys and then retype the correct passnumber from the beginning. Note that the **'ENT'** key does not need to be pressed after the passnumber has been entered.

1. Installation Setup Menu:

Typing the passnumber **1234** on the front panel keypad enters this menu.

This menu allows the user to:

- Alter the clock settings – date and time
- Access the manual control functions (via the *manual* submenu).
- Define the probe/cell status (via the *probe* menu).

2. Outputs Setup Menu:

Typing the passnumber 8888 on the front panel keypad enters this menu.

This menu allows the user to:

- Examine/configure setpoint values for alarm digital outputs
- Configure any analogue outputs
- Examine/configure setpoint values for group alarm digital outputs
- Configure a "held DO" digital output for external control systems

3. Instrument Specific Setup Menu:

Typing the passnumber 3333 on the front panel keypad enters this menu.

This menu allows the user to:

- Set the calibration and exercise frequencies
- Set the type of calibration
- Set the criteria that dictate if a calibration is accepted or not

4. **General Setup Menu:**

Typing the pass number 1984 on the front panel keypad enters this menu.

This menu allows the user to:

- Set the clock
- Set the high and low values for the parameters being recorded. (This also scales the analogue outputs)
- Set the instrument address on a multidrop loop
- Configure the communications ports
- View the analogue input values
- View the digital input status
- Manually switch the digital outputs status
- Test the communications facility

5. **Maintenance Menu:**

Typing the pass number 9999 on the front panel keypad enters this menu.

This menu allows the user to:

- Test the pneumatic piston
- Test the aerate function
- Set the piston movement delay time (PMD) (This is the time that the compressor is allowed to run for when moving the piston either up or down. If there is a remote sensor at a long distance from the main panel, the PMD time may have to be increased to allow sufficient time to pressurise the line).

6. **Altitude Menu:**

Typing the pass number 1985 on the front panel keypad enters this menu.

This menu allows the user to:

- Input the operating altitude of the instrument for sites significantly above sea level. See section 8.8 for further details.

7. **Depth of Immersion Menu:**

Typing the pass number 1986 on the front keypad enters this menu.

This menu allows the user to:

- Enter the DO sensor's depth of immersion in the calibrating or measuring position if significantly different from the assumed 20cm. See section 8.9 for further details.

8. **Salinity Menu:**

Typing the pass number 1987 on the front panel keypad enters this menu.

This menu allows the user to:

- Enter the salinity of the measured medium if significantly different from the assumed zero salinity – clean water. See section 8.10 for further details.

9. **Barometric Pressure Menu:**

Typing the pass number 1988 on the front panel keypad enters this menu.

This menu allows the user to:

- Enter the DO sensor's barometric pressure if significantly different from the assumed 760mm mercury (1013 mbar). See section 8.11 for further details.

10. **Logged Events menu:**

Typing the pass number 2512 on the front panel keypad enters this menu.

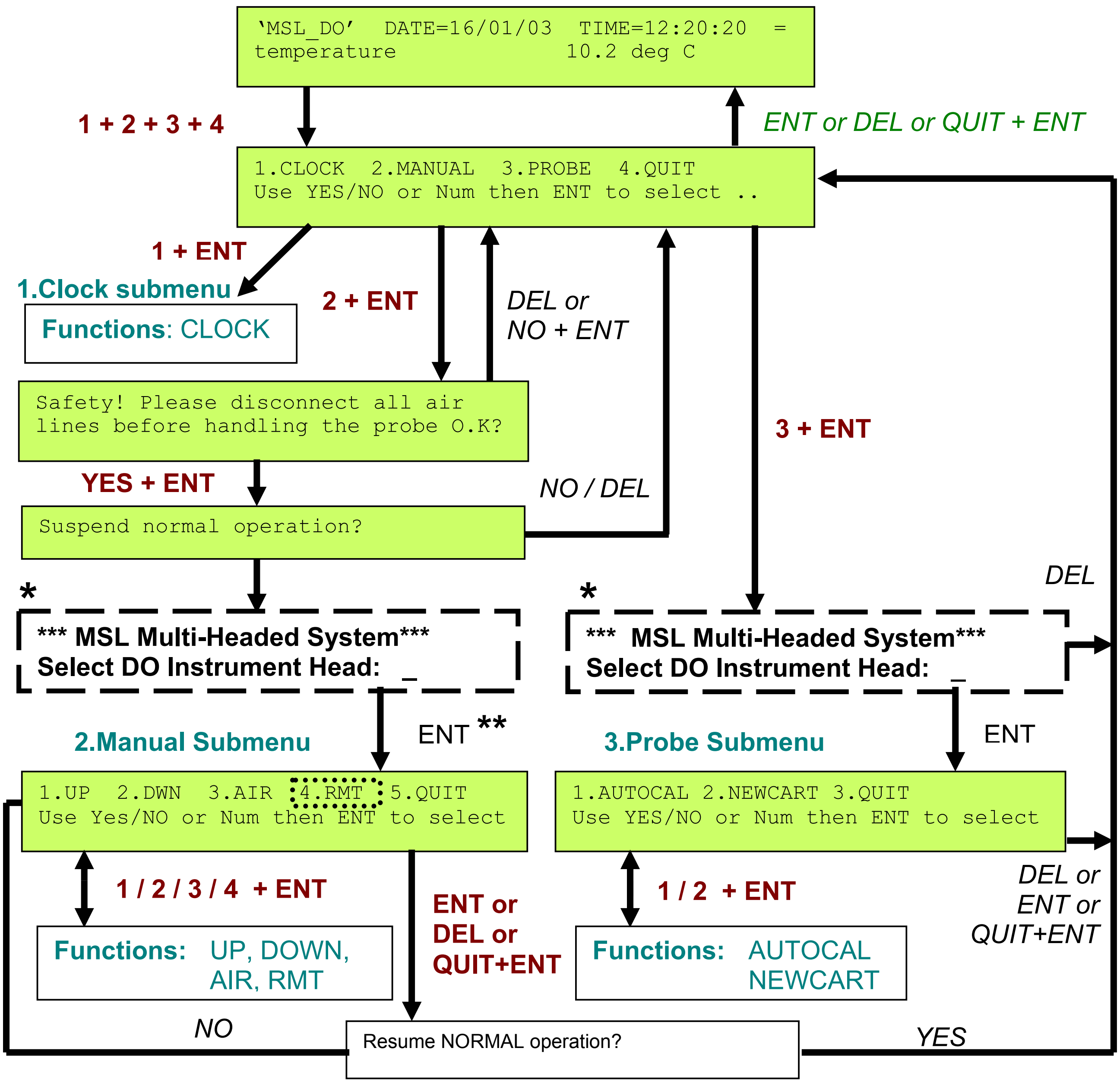
This menu allows the user to:

- View the last 100 significant events that have been carried out by the instrument. See section 8.12 for further details

[Section spacer Page]

8.3 Installation Setup Menu (Pass number 1234)

Typing the passnumber 1234 on the front panel keypad enters this menu. This menu accesses the maintenance functions and clock display. It allows testing of the wet end assembly and/or setting up of the wet end assembly for calibration after maintenance. The following diagram shows how these functions may be accessed:



☞	* **	This text will not appear if only one DO sensor is installed RMT (REMOTE) will not appear unless a local control box is installed.

Figure 29 – Installation '1234' menu navigation flowchart

8.3.1 Overview of functions accessed via the Installation Setup Menus

Main Screen Menu: 1.CLOCK 2.MANUAL 3.PROBE

CLOCK	Sets the system clock – required for data logging
MANUAL	Access to manual submenu: UP, DOWN, AIR, RMT
PROBE	Access to probe submenu: AUTOCAL, NEWCART

Manual Submenu: UP, DOWN, AIR, RMT

UP	Moves the probe up into the shroud/ball.
DWN (DOWN)	Moves the probe down into the process.
AIR (AERATE)	Force calibration air past the DO probe assembly (maximum duration 30 minutes).
RMT (REMOTE)	Enables the user to operate the UP, DOWN and AERATE functions from (if applicable) a local control box adjacent to the remote DO probe.

Probe Submenu: 1.AUTOCAL 2.NEWCART

AUTOCAL	Flags that a DO autocalibration is to be carried out as soon as possible.
NEWCART	Flags that the DO 100% calibration factors must be recalculated at the next calibration to take account of the new DO cell characteristics.

SEVERN TRENT SERVICES

8.3.2 Installation Setup Menu – Detailed Instructions

Typing the pass number 1234 on the front panel keypad enters this menu. The maintenance functions and clock are accessed using this menu. It allows testing of the wet end assembly and/or the setting up of the wet end assembly for calibration after maintenance.

On initial power-up, the instrument will display the following message on the LCD screen if the clock has not previously been set.

```
'MSL_DO' **PLEASE SET CLOCK**         N
temperature        10.2 deg C
```

The clock is battery-backed and therefore its settings are retained on power loss. It may, however, require setting if the clock values drift, the battery link has been removed, or the battery requires replacement.

On entry of the pass number 1234 the user will be presented with the following display:

```
1.CLOCK 2.MANUAL 3.PROBE 4.QUIT
Use YES/NO or Num then ENT to select..
```

Selecting an appropriate option number will present the user with a less cryptic message of the menu option on the second line of the LCD. This is mainly for casual users. Pressing the ENT will select this option. This option will then drop straight into the user function or display a further submenu.

> ☞ Please note that on entry to a menu, if 'DEL' or 'ENT' is pressed before Selecting an option number then a 'QUIT' request is assumed and the user will be returned to the previous menu.

CLOCK

The clock settings can be changed by selecting option '1.CLOCK' from the 1234 menu. The user will then be presented with a display similar to the one shown below and may alter the date and time as required.

```
====  Clock Menu ====
16/01/2003   15:48:16
```

The date is displayed in the UK Day/Month/Year format i.e., DD/MM/YYYY and the time in 24-hour clock format (HH/MM/SS). This format is hard coded in the software and cannot be changed. In the above example, the time is 48 minutes and 16 seconds past 3 o'clock in the afternoon on the 16th January 2003.

The cursor initially appears over the separator to the right of the day entry. To change the value in this field simply type in the new value using the keypad, then press 'YES' when finished. A further press of 'YES' will move the cursor to the right of the month field, and so on. In this way, each field may be edited. Pressing 'DEL' while entering a number will remove the last character typed. If no characters are available to delete then the entry will be aborted. Pressing 'NO' will move the cursor back to the left. Pressing 'DEL' when not entering a number in a field will exit this menu and produce the following message:

```
Press YES to update clock …
08/09/1994 15:48:25
```

If 'YES' is selected then the clock will be updated with the time and date shown. In this way, the clock can be set accurately at the press of the 'YES' key.

If the instrument detects invalid date/time values when setting the clock then the following message will be displayed for a short time (NB: day incorrectly set to 44) …

```
Error.  clock update failed
44/04/1994 15:48:17
```

… indicating that no action was taken with the date/time settings shown. The user must now re-select the clock functions and enter the time correctly.

If 'NO' is selected the following message will be displayed on the screen for a short time before continuing to exit:

```
Aborted!
08/09/1994   15:48:25
```

On exit, the following question will always be displayed:

```
Display date/time on LCD top line?
```

A 'YES' response will make the instrument display the date and time on the MAIN SCREEN. A 'NO' response will **not** display the date and time on the top line of the main screen. In this case, the instrument will display two consecutive inputs on the MAIN SCREEN. The default for the instrument is to display the date and time on the top line of the LCD.

The user is now returned to the Main Screen.

1. MANUAL

On selection of option 2 the user will be presented with the following question:-

```
SAFETY! Please disconnect all air lines
before handling the probe O.K?
```

WARNING

This is a safety message to remind the user to disconnect all air lines before removing the probe from the process otherwise the piston may cause injury if accidentally operated.

Do not disconnect air lines if you wish only to observe the operation of the wet end in-situ.

The user must press the 'YES' key followed by the 'ENT' key in order to proceed. A 'DEL' or 'NO' key press will return the user to the 1234 menu.

Answering 'YES' will display a further question asking if you want to suspend normal operation:

```
Suspend NORMAL operation?
```

If the 'YES' key is pressed, the instrument is taken off line with its current DO signals held and the Manual submenu is displayed.

If the 'NO' or 'DEL' key is pressed the user is returned to the 1234 menu.

If the DO System has more than one DO probe then the user will be presented with the following screen:

```
***MSL Multi-Headed System***
Select DO Instrument Head:  _
```

Before proceeding with a multi-headed system, the user will need to identify the number of the probe to be tested. Use the keypad to select the required DO probe assembly by pressing '1' or 2 as appropriate, then pressing 'ENT', or press 'DEL' to abort. If a head has been selected the Manual submenu will be displayed.

☞ Please note that the *Manual submenu* is entered automatically if a 'YES' response is given to the "Suspend NORMAL operation" question.

Manual submenu

```
1.UP 2.DWN 3.AIR  4.RMT   5.QUIT
Use YES/NO or Num then ENT to select..
```

☞ The 4.RMT (REMOTE) option will only be displayed if the head selected has a Local Control Box (LCB).

Selecting the appropriate option number, by pressing the appropriate number on the keypad then pressing 'ENT', will allow the user to exercise and test the wet end assembly. The following pages detail the functions available under this menu.

1. **UP** - Selection of option '1.UP' will result in the probe moving out of the process up into the shroud. The screen will display the following message whilst this is happening:

```
Probe moving out of process...
```

The display will revert to Manual submenu once this operation has been performed.

2. **DWN (DOWN).** Selecting option '2.DWN' will move the probe down into the process liquor. The screen will display the following message whilst this is happening:

```
Probe moving in to process...
```

The display will again revert to the Manual submenu once this operation has been performed.

3. **AIR (AERATE)**. Selecting option 3.AIR opens the aerate valve so that the calibration air forces its way past the DO probe assembly. This will result in visible bubbled of air rising around the wet end assembly if it is installed in the process. The screen will display the following message whilst this is happening:

```
Press a key to stop aeration …
Temp = 12.2 °C; DO = 99.5 %sat
```

Pressing any key on the front panel keypad stops the aeration and returns the user to the Manual submenu.

☞ If the user does not abort the aeration sooner, aeration is stopped automatically after 30 minutes, just as if the user had pressed a key. This is to protect the compressor from overheating and possible burnout through over prolonged operation.

4. **RMT (REMOTE) [If applicable]. S**election of option ‘4.RMT’ will allow the user to operate the UP, DOWN and AERATE functions from a Local Control Box (LCB). The screen will display the following question:

```
Confirm, Enter Remote Mode [YES/NO]?
```

A ‘NO’ response will return the user to the Manual Submenu.
A ‘YES’ response results in the following message being displayed:

```
*REMOTE MODE*  (press any key to exit)
Air supply OFF
```

The user can now press the buttons on the local control box to operate the ‘UP’, ‘DOWN’ and ‘AERATE’ functions.

☞ **The air supply button must be pressed and held down when any of the other function buttons are being operated.**

While the air supply button is pressed on the Local Control Box the message shown in the bottom line will read “Air supply ON”.

Pressing any key will exit the menu and return to the Manual Submenu.

5. **QUIT** - Pressing ‘QUIT’ + ‘ENT’ or ‘DEL’ or ‘ENT’ on its own will cause the following question to be displayed:

```
Resume NORMAL operation?
```

A ‘NO’ response will return the user to the Manual submenu; A ‘YES’ response returns the user to the 1234 menu from where the user can return to the main screen using ‘DEL’ or ‘ENT’ or’ QUIT’ then ‘ENT’.

WARNING

The DO system will now make sure all probe assemblies are in the process.
This means that the pneumatic probe assemblies will operate.

3. Probe

If the DO System has more than one probe assembly then selecting option 3 from the 1234 menu presents the user with the "select D.O Instrument head" screen previously mentioned

Probe Submenu

The Probe submenu presents the user with the following display:-

```
1.AUTOCAL 2.NEWCART 3.QUIT
Use YES/NO or Num then ENT to select…
```

The following paragraphs describe the function of these options.

1. AUTOCAL - Selection of option 1.AUTOCAL will display the following question:

```
Trigger auto-calibration?
```

A 'YES' response sets the *immediate* DO calibration requested software flag. The software will see this flag become set and calibration will occur as soon as possible, depending on what the instrument is currently doing. This means that if any exercise/clean is in process or a calibration on another assembly is in progress then the user must wait. Calibrations for the same assembly **cannot** be queued so if the current assembly is already in any part of a calibration cycle then a further calibration will not occur. If the user has answered "No" to the "Calibrate if alarm active?" question ('8888' menu – see page 100) then a calibration will not occur until all alarms related to this assembly are inactive.

A 'NO' response clears the immediate DO calibration flag but will **not** stop a calibration that is already taking place.

2. NEWCART Selection of option 2.NEWCART will display the following message:

```
Does DO cartridge have a new span?
```

A 'YES' response to the question "Does the DO cartridge have a new span?" sets the *new/changed* DO cell flag. If the DO cell/cartridge has been changed or a new membrane fitted then the user must press 'YES'. This tells the system to recalculate calibration factors that relate to new/changed cell characteristics. The system will recalibrate as soon as possible (Please see 'YES' response of 1. AUTOCAL above).

A 'NO' response clears the software's *new/changed* cell flag. Please be aware that if this is done while a calibration is in progress and <u>before</u> the signal span adjustment point then this assemblies '*new'* will cancel.

3. QUIT Pressing 'DEL', 'ENT' or 'QUIT' then 'ENT' returns the user to the 1234 menu.

8.4 Outputs Setup Menu (Passnumber 8888)

Typing the passnumber 8888 on the front panel keypad enters this menu. This lets the user examine or configure the set point values for any alarm digital outputs and/or configure any analogue outputs to their own particular requirements. The following diagram shows how these functions may be accessed:

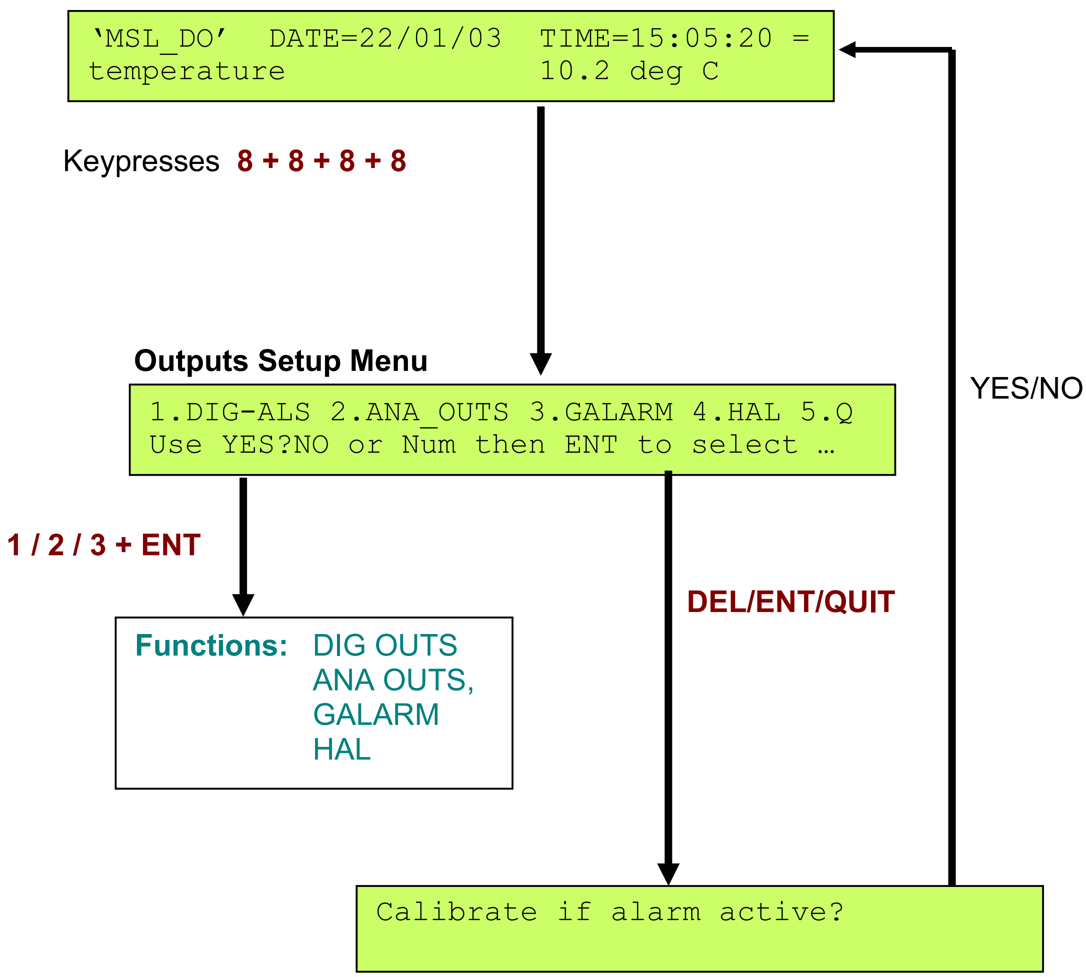


Figure 30 - Outputs Setup '8888' menu navigation flowchart

8.4.1 Overview of functions accessed via the Outputs Setup Menu

DIG_ALAR This lets the user set the alarm type and the limits for each available alarm output channel. It provides the conventional implementation of alarms. See also "GALARM".

ANA_OUTS This lets the user assignment of any one parameter of their choosing to each of the available analogue output channels.

GALARM This allows for setting up of a ***grouped alarm***. This single alarm can be triggered by any one of a group of input conditions. Using this facility you could set up a single alarm to fire conditional upon a group of input circumstances - For example if the DO was below 1.0 mg/L **OR** the DO was above 3.0 mg/L **OR** the temperature was above 30 degrees Celsius **OR** (etc…)

[GALARM1; GALARM2]	Accesses sub-menus GALARM1 and GALARM2 that let the user set lower and / or upper setpoints on *each* input.

HAL This lets the user designate which (if any) alarm digital output to raise when the instrument is not in the measuring position i.e. it is in maintenance mode or calibrating or cleaning. In this circumstance the instrument's designated 'HAL' output signal will be a sampled and held value. The alarm set up to reflect this is called the signals' **H**eld **AL**arm output - hence "HAL"

8.4.2 Outputs Setup Menu - Detailed Instructions

Typing the pass number 8888 on the front panel keypad enters this menu. As mentioned previously, the user may now examine/configure the set point values for any alarm digital outputs and/ or configure any analogue outputs to user requirements.

On entry of a valid passnumber the user will be presented with the following display:

```
1.DIG_ALS 2.ANA_OUTS 3.GALARM 4.HAL 5.Q
Use YES/NO or Num the ENT to select……
```

Pressing the keypad number corresponding to the appropriate option number presents the user with a less cryptic description of the menu option corresponding to that option on the second line of the LCD. This feature is provided mainly for casual users. Pressing 'ENT' will then select this option. This option will then drop into the selected user function. (See the notes below)

Note 1:

On entering this menu, if 'DEL' or 'ENT' is pressed before selecting an option number then 'QUIT' is always assumed and the user will be returned to the *previous* menu.

Pressing 'DEL' immediately on entering this menu will take the user straight to the **"Calibrate if in alarm?"** question explained under the option 'QUIT' at the end of this section.

Note 2:

If the system has no available alarm outputs, the DIG_ALS and GALARM menus will display the following messages for a few seconds:

```
No ALARM OUTPUTS available.
```

Note 3:

If the system has no available analogue outputs the ANA_OUTS menu will display the following message for a few seconds:

```
No ANALOGUE OUTPUTS available
```

The following pages detail the functions available under each of these output setup menus.

1. DIG_ALARS

Selecting option 1 from the Outputs Setup Menu presents the user with something similar to the following display:

```
ALM Input Name:  Type  LimVal  On   ALC
01: absolute d.o hi.1  0.000   Y    010
```

'ALM' is the alarm channel number assigned by the software in the instrument and cannot be edited. The user can assign one of the instrument's parameter names (Input Name) to each available alarm channel, and set the type (Type) and level of alarm ('LimVal'). The ALM channels are numbered sequentially from one. The total number of channels available depends on the instrument configuration at time of purchase.

Each field can only take a specific value or name. The 'YES' and 'NO' keys are used to move to a field and 'ENT' is pressed to change its contents. Note that the cursor is at the end of the field before it is selected and moves to the beginning after 'ENT' has been pressed. See below

```
ALM Input Name:  Type LimVal  On    ALC
01: absolute d.o█hi   0.000   Y     010
```

Cursor is at the end of the 'input name' field before selection

```
ALM Input Name:  Type LimVal  On   ALC
01:█absolute d.o  hi   0.000   Y    010
```

Cursor moves to the beginning of the 'input name' field after selection

The user can then scroll between available options using the 'YES' and 'NO' keys or numeric key presses as detailed below. Use 'ENT' to select the required option or 'DEL' to retain the old setting.

Parameter	**Option selection available**	**Numeric Key presses + ENT**
TYPE	lo.1	0
	hi.1	1
	lo.0	2
	hi.0	3

lo.1, hi.1 : if the limit is breached then set the alarm output high.
lo.0, hi.0 : if the limit is breached then set the alarm output low.

The limit is deemed breached if the magnitude of the signal is greater than the hi value set as 'LimVal' for a high alarm, or less than the lo value set as 'LimVal' for a low alarm.

LIM VAL	The *Lim Val* value is entered in the engineering units of the selected signal. When the set limit value is breached the alarm output will trigger provided that the alarm is enabled.

On — **n** – means No, do not enable the alarm output. Even if the alarm condition is breached, do not modify the corresponding digital output's state.

On — **Y** – Means yes, do physically activate the alarm output when the limit is breached. Deactivate the alarm output when within or actually equal to the set limit value.

ALC — The **A**larm **L**imit condition **C**ounter (ALC) provides a simple mechanism to set the sensitivity of an alarm output. The software continuously loops checking to see if an alarm condition has occurred. It makes this check once per second. Each time the checked input is found to have breached the alarm condition, it increments a counter. Only when this counter has reached the number set by 'ALC' will the digital output actually be changed to reflect the alarm condition. This programmable count ensures the alarm limit has definitely been breached and the value is just not hovering or bouncing around its limit setting.

The default value for ALC is 10. This means that the alarm will not actually be accepted unless the software has checked the specified input and seen it in breach of its alarm conditions on 10 consecutive checks. If it is in breach 9 times in a row, and on the tenth it is not, the counter would be set back to zero and the checking process would start from scratch. The acceptable range to which ALC can be set to is zero to 900. It is unlikely you would need to change ALC. Setting ALC to zero is not recommended. It would tell the software to accept even a single transient check as a genuine breach of the alarm conditions and if the input signal was hovering around its limit, could result in the alarm output oscillating.

When an alarm is active (on) the system shows an active alarm '*' (asterisk or star symbol) on the top right of the front panel display and in addition will display either <lo or >hi next to the signal if it happens to be currently showing on the LCD.

Example… With a Double-Headed Dissolved oxygen instrument currently displaying...

```
'MSL_DO' DATE=22/01/03 TIME=09:07:39    =
autocal d.o 1   64.3% sat               =
```

Entering the '8888' menu, then selecting 1.DIG_ALS will produces something like:

```
ALM Input Name:    Type  LimVal  On   ALC
01: absolute d.o   hi.1  0.000   n    010
```

If you edited this display as described earlier to read:

```
ALM Input Name:  Type    LimVal  On   ALC
01: absolute d.o hi.1    40.0    Y    010
```

You would now have set up the first available digital alarm output, number 1, such that if the value of absolute DO in % saturation exceeded 40.0% on 10 consecutive readings, then the alarm output would be switched high. If you had set up alarm 1 as described, and returned the instrument to the normal measuring mode, and the autocalibrated DO on head 1 had remained at 64.3% saturation, the LCD would now be displaying:

```
'MSL_DO' DATE=22/01/03 TIME=10:28:39   = *
Autocal d.o 1  64.3 % sat      >hi     =
```

The '*' at the right hand side of the top line indicates that one or more alarms are currently being breached. In this example the '>hi' shows the autocal d.o head 1 is reading above its high alarm set point, because '>hi' is being displayed to the right of its current value. If the LCD did not happen to be currently displaying the line for autocal d.o 1, then you would not see the '>hi'.

> If you see a '*' on the top right of the display, indicating an alarm has been breached, then it may be necessary to use the 'YES' and 'NO' keys to scroll the display to see which particular parameter(s) have breached the alarm setting. Do this by scrolling through looking for the text '>hi' or '<lo' against the name of the particular parameter in breach.

The preceding text has described setting up a simple high and low alarm or alarms. There is a more complex possibility for configuration of alarms. In the simple example of alarm setup one alarm is dedicated to one state of one input - i.e. alarm 1 can be a low alarm for parameter 1; if you wanted a high alarm too for parameter 1 you would assign a different alarm output, say alarm 2, to be a high alarm on parameter 1.

However, using DIG_ALS in conjunction with GALARM the user can set a **single** alarm output to operate on more than one alarm condition.

In earlier products, the switching state of these alarm settings could not be in opposition. That is say

lo.1 and hi.0 \
or } ……. Originally never permitted
lo.0 and hi.1 /

(i.e. could not be used) at the same time because no alarm rest state was defined. For example if the alarm was off (0) if the value was below a certain number (lo.0) and it was on (1) if it was above another certain number (hi.1), should it be on or off when it was between these numbers? This condition represented an indeterminate state and if the user set up alarms in this state it caused the display of a '!<>' next to any related input signals if they were displayed. This was intended to draw attention to the fact that conflicting or indeterminate alarm conditions had been set up.

This condition has been partially relaxed in Series 5000 instruments. A setting of

lo.1 and hi.0 \
or } … Is now permitted **on the same input signal**
io.0 and hi.1 /

via DIG_ALS and/or GALARM.

This condition has been made a special case. It will result in switching the output on when one of the limits is breached and off when the other limit is breached. However, when the signal reverts so it is not in breach of either limit the alarm output will not immediately switch its state as 'normal' but will remain in the off/on state that it is last switched to. This allows a very simple limited form of process control to be attempted using only a single digital output…

An example follows…

For example…

Let us say we have set up an alarm on an autocalibrated, held Dissolved Oxygen signal such that we have….

	lo.1 set at 1.0 mg/l	\	
and		}	**<u>on the same input signal</u>**
	hi.0 set at 3.0 mg/l	/	

Now let us imagine that the DO level drops to 0.95 mg/l. This would turn on (state=1) the low.1 digital alarm output that we assigned. Say this then caused an aerator to be switched on. The DO now rises as a result; 0.99 → 1.00→1.01 mg/L. we might now expect the aerator to be switched off again, because we are now no longer in breach of the low (lo.1) alarm level (set at 1.0 mg/L). However, this will <u>not</u> happen in this special case! The aerator would stay on. The DO would continue to rise; 1.5 → 2.0 → 3.0 → 3.01 mg/L. As soon as the DO rose above 3.0 mg/L breaching the high alarm (hi.0), the digital output would be switched off because it is set up as a hi.0 alarm. This in turn in our example would turn off the aerator. The DO would then start to fall → 3.05 → 3.00 → 2.99. Again we might expect that as soon as the DO dropped below 3.0, when we are no longer in breach of the hi.0 alarm limit of 3.0 mg/L and that the digital output state would revert to 1 (on). Again in this special case it would <u>not</u>. Only when the DO fell to below 1.0 mg/L, to the lo.1 limit, would the digital output change to 1 (on). And so the procedure would repeat.

As can be seen, it is possible to use a single digital alarm output to provide simple DO control so that the DO, in this case, was maintained reasonably closely to keep within the working range 1 to 3 mg/L.

This ends the discussion on DIG_ALARS.

To exit the alarms sub-menus, press the 'DEL' key to step back through the various sub-menus until you back to the main display screen.

2. ANA_OUTS

On selecting option 2 from the outputs setup menu the user will be presented with the following display:

```
AOP Input [mg/l]        4mA       20mA
01: absolute DO        0.000      15.00
```

The analogue output channel (AOP) as perceived by the instrument cannot be edited, but the user is able to assign any one of the instrument's parameter names to each of the available analogue outputs. The channels are numbered sequentially from 01. The total number of channels available depends on the instrument configuration at time of purchase.

Each field can only take a specific value or name. The 'YES' and 'NO' keys are used to move to a field and 'ENT' is pressed to change its contents, at which point 'YES' and 'NO' will scroll between the available options. When the required option is displayed 'ENT' is pressed to select it, or 'DEL' is pressed to retain the old settings.

☞ The engineering units reference provided on the top line of the display will only change to the engineering units of the newly selected item once the user has completed their input name selection.

Please DO NOT adjust the 4mA and 20mA values indiscriminately as some of the inputs are tailored to the operation of the system.

Press 'DEL' when you have finished with this menu to return to the Outputs Setup Menu

3. GALARM

The GALARM sub-menu allows setting up a GROUPED ALARM. This single physical alarm can be triggered by any one of a *group* of input conditions. This gives you the ability to set up a single alarm to fire conditional upon a group of input circumstances - for example if the DO was below 1.0 mg/l **or** the DO was above 3.0 mg/l **or** the temperature was below 5 degrees Celsius **or** the temperature was above 30 degrees Celsius **or** … (etc.)

[GALARM1 \ GALARM2] /	Accesses two sub-menus - GALARM1 and GALARM2 – that let the user set lower and/or upper setpoints on each input.

```
1.GALARM  2. GALARM2  3. QUIT
Use YES/NO or Num then ENT to select….
```

The user now has access to two very similar sub-menus. These allow the user to set two individual alarm set points for each available input and to point them at (assign them to) any available alarm output. Using this facility the user can group/combine alarm conditions to meet site-specific control or alarm requirements.

Each individual sub-menu gives the following display:

GALARM1:

```
INP Input [GAL1]  Type  LimVal AlmOut
01:d.o input (D)  hi.1  0.000    0
```

GALARM2:

```
INP Input [GAL2]  Type  LimVal AlmOut
01: d.o input (D) hi.1  0.000    0
```

As can be seen they are identical except for the [GAL1] and [GAL2] reference on the top line.

These menus let the user look at all available inputs, set up alarm limits, and specify which alarm outputs should be activated when the limit is breached. The alarm output number chosen *('AlmOut'* on the right of the display*)* relates to the index of the signal as shown in **DIG_ALS** menu. Setting an 'AlmOut' to zero indicates that this entry is disabled (i.e. is never activated – it "goes nowhere").

By using the GALARM1/GALARM2 facility, for example, the user can create alarm *groups* if there are not enough *individual* alarm outputs available. This is achieved by assigning a number of *different* alarm conditions to the *same* single alarm output.

SEVERN TRENT SERVICES

The reason that there are 2 menus - GALARM1 and GALARM2 is that you may wish to set both a high alarm condition and a low alarm condition on the same signal. If this were the case, you would use GALARM1 to set one condition, and GALARM2 to set the other – for example:

GALARM1:

```
INP Input [GAL2] Type   LimVal   AlmOut
01:a.cal.do 1    hi.1    1.0       1
```

GALARM2:

```
INP Input [GAL2] Type   LimVal   AlmOut
01:a.cal.do 1    hi.1    3.0       1
```

This would set up a single Alarm Output (AlmOut) 1, to be switched **ON (1)** (types are lo. **1** and hi. **1**) when the DO was below 1.0 mg/l <u>or</u> it was above 3.0 mg/l. If the DO were within 1.0 and 3.0 mg/l the alarm would be off.

Now, imagine that the temperature on this same instrument is signal number 4. If now you scrolled through the inputs so you reached the temperature signal, and modified the setting in GALARM1 and GALARM2 to be:

GALARM1:

```
INP Input [GAL1] Type  LimVal   AlmOut
04:Temperature   lo.1  5.0        1
```

GALARM2:

```
INP Input [GAL2] Type  LimVal   AlmOut
04: Temperature  hi.1  30.0       1
```

This, in combination with the previous settings, would set up a single alarm output ('AlmOut') - that numbered 1 - to be switched **on** (types are lo. **1** and hi. **1**) when the DO was below 1.0 mg/l *or* it was above 3.0 mg/l, *or* if the temperature was less than 5 degrees C *or* if it was above 30 degrees C. If the DO was within the range 1.0 to 3.0 mg/l and the temperature was between 5 and 30 degrees C, then alarm would be off.

Assuming you had set up alarm 1 as described, and returned the instrument to the normal measuring mode, and the autocalibrated DO on head 1 became 0.9 mg/l (which is less than the lo.1) alarm, but the temperature was 20 degrees C (which is in range), then if you happened to be displaying the autocal DO signal the display might be …

```
'MSL_DO' DATE=24/01/00 TIME=09:07:39        = *
autocal DO 1       0.9 mg/l       <lo       =
```

Whereas if you were displaying the temperature it would be…

```
'MSL_DO' DATE=24/01/00 TIME=09:07:39        = *
temperature        20 deg c                 =
```

The '*' at the right hand side of the top line indicates that one or more alarms have been breached.

In this example the ‘<lo’ visible with the autocal do for head 1 display shows the autocal DO of head 1 is reading below its alarm set point. In the second example where temperature is being displayed, because the LCD is not currently showing the line for autocal DO 1, you would not see the ‘<lo’. If the top line displays an asterisk at the right hand end, it means an alarm condition is active. However, you might well need to scroll through the display to see *which* alarm signal has a condition that has been breached. Note also that if you have set up a grouped alarm, then possibly more than one signal could have breached its alarm setting.

When you see a ‘*’ on the top right of this display, indicating an alarm has been breached, use the ‘YES’ and ‘NO’ keys to scroll the display if you want to see which particular parameter(s) have breached the alarm setting. Scroll through looking for the text ‘>hi’ or ‘<lo’ against the particular parameter name.

The preceding text has described the setting up of a simple high or low alarm or alarms, either as a single or as a grouped alarm. There is a more complex possibility for configuration of alarms. In the simple example of alarm setup one alarm is dedicated to one state of one input – i.e. GALARM 1 can be a low alarm for parameter 1; if you wanted a high alarm too for parameter 1 you would assign GALARM 2 for that same signal to the same alarm output, as in the earlier example.

Using DIG-ALS in conjunction with GALARM the user can set a **single** alarm output to operate on **more than one** alarm condition.

In earlier AZTEC SERIES 5000 products, the switching state of these alarm settings could not be in opposition. That is to say

lo. 1 and hi. 0 \
or } … Originally was never permitted
lo. 0 and hi. 1 /

(i.e. could **not** be used) at the same time because no alarm rest state was defined. For example if the alarm was off (0) if the value was below a certain number (lo.0) and it was on (1) if it was above another certain number (hi.1), then should it be on or off when it was between these numbers? This condition represented an indeterminate state, and if the user had set up alarms in this state it caused the display of a **‘!<>’** next to any related input signals if they were displayed. This was intended to draw attention to the fact that conflicting or indeterminate alarm conditions had been set up.

However, with all Series 5000 products this restriction has now been partially relaxed. A setting of

lo. 1 and *hi.0* \
or } … is now permitted on the **same input signal**
lo. 0 and *hi.1* /

via DIG_ALS and/or GALARM

This combination of conditions has been made a **special case**. It will result in switching the output ON when one of the limits is breached and OFF when the other limit is breached. However, when the signal reverts so it is not in breach of either limit the alarm output will NOT immediately switch state as ‘normal’ but will remain in the off/on state that it is last switched to. This allows a very simple limited form of control to be attempted using only a single digital output…

For example…

Let us say we have set up an alarm, or a grouped alarm, on an autocalibrated, held Dissolved Oxygen signal such that we have…

lo.1 set at 1.0 mg/l \
and } on the **same** DO level signal
hi.0 set at 3.0 mg/l /

Now let us imagine that the DO level drops to 0.95 mg/l. This would turn on (state = 1) the low.1 digital alarm we assigned. Say this then caused an aerator to be switched on. The DO will now rise; 0.99 $\rightarrow$ 1.00 $\rightarrow$1.01 mg/l. We might now expect the aerator to be switched off again, because we are now no longer in breach of the low (lo 1) alarm level (which we set at 1.0 mg/l). However, this **won’t** happen in this special case! The aerator would stay on. The DO would continue to rise; 1.5 $\rightarrow$ 2.0 $\rightarrow$ 2.9 $\rightarrow$ 3.0 $\rightarrow$ 3.01 mg/l. As soon as the DO rose above 3.0 mg/l, breaching our high alarm setting (hi.0), then the digital output would be switched off (because it is set up as a hi.0) alarm. This in turn in our example would turn off the aerator. Now the DO would then start to fall; 3.05 $\rightarrow$ 3.00 $\rightarrow$ 2.99 mg/l. Again, we might expect that as soon as the DO dropped below 3.0 mg/l and we were no longer in breach of our hi.0 alarm limit of 3.0 mg/l that the digital output state would revert to 1 (on). Again in this special case, it **wouldn’t**. Only when the DO fell below 1.0 mg/l, our lo.1 limit would the digital output change to 1 (on). And so the procedure would repeat.

As can be seen from this example, it would be possible to use a single digital alarm output to provide simple control so that the DO, in this case, was maintained reasonably closely to keep within the working range, in this case 1 to 3 mg/l. We would have to make sure if we used a grouped alarm for this purpose and included other signals as well as DO, that we were not setting up indeterminate or conflicting states. If a condition were set up where the combination of alarm levels and states were such that the software just could not tell whether an alarm condition had occurred, would show **‘!<>’** indicating basically that the software was unable to decipher what we intended by the alarm setup we had programmed!

This ends the discussion on G_ALARM. To exit the alarms submenus, press the ‘DEL’ key to step back through the various submenus until you get back to the main display screen.

4. HAL

This option allows the user to designate which (if any) alarm digital output to raise when the instrument is not in the measuring position. In this circumstance, the instrument's output signal is a sampled and held value. The alarm set up to reflect this is called the signals **H**eld **Al**arm – hence ' HAL'.

On selecting option 4 from the Outputs Setup Menu the user will be presented with the following display:

```
*** MSL Multi-Headed System ***
Select DO Instrument Head:        _
```

> ☞ Reference to the multi headed DO probe system will only be shown if a Multi-Headed DO System is installed.

Use the keypad to select the appropriate DO head and press ENT to display the following input display:

```
Set alarm output for DO held alarm:
0
```

This prompts the user to select digital (alarm) output that the system will use to indicate to an external control system that this sensor is not in the measuring position (i.e. is holding its held signals). A setting of zero disables this feature. The digital (alarm) output chosen must be available and will no longer operate as a normal alarm even if enabled in the DIG_ALS or GALARM menus.

Please note that there is no warning if the alarm output selected is not available. The user must re-enter the menu and check that the setting has been accepted.

To return to the Outputs menu press 'DEL'

On exit, the following question will always be asked.

```
Calibrate if an alarm active?
```

This allows the user to decide if an active alarm inhibits DO calibrations. It stops the control DO signal being held outside defined alarm conditions which may adversely affect any attached control system. If the alarm outputs are being used to provide active fault alarms then answer 'YES' to this question.

The default is to not calibrate if an alarm is active. The only override to this is when a DO system loses power and on subsequent power-up has lost its memory (cold start). In this case, it must go through a DO calibration before going back on-line.

5. **[QUIT]**

On exit, the following question will always be asked:

```
Calibrate if an alarm active?
```

This allows the user to decide if an active alarm, i.e. an alarm currently triggered, inhibits DO calibrations. It stops the control DO signal being held outside defined alarm conditions, which may adversely affect any attached control system.

☞ If the alarm outputs are being used to provide active fault alarms then answer YES to this question.

The default is to not calibrate if an alarm is active. The only override to this is when a DO system loses power an on subsequent power-up has lost its memory (code start). In this case it must go through a DO calibration before going back on-line.

On answering YES/No to the question, the user is returned to the Main Screen.

Answering NO to this question when using alarm outputs to provide active fault alarms can lead to a problem where an AZTEC DO system or derivative starts a programmed clean or calibration cycle that fails to complete. Subsequently, the instrument may fail to recover automatically.

- This problem has occurred in unexpectedly cold weather due to the pneumatic cylinder freezing during a clean or a calibration cycle. At the end of the cycle, the cylinder failed to replace the sensor in the process and the resulting high DO alarm (because the sensor remained in air) prevented further clean / calibration cycles which would otherwise have lead to recovery.

- The problem *could* occur for any other reason resulting in the cylinder sticking in the extended or part-extended position during cleaning or calibration.

- This problem can only occur if you have set up digital alarm output(s) and you have answered ‘NO’ to “calibrate in alarm?” and a clean or calibrate fails part through with the cylinder partly or fully extended.

8.5 Instrument Specific Setup Menu (Passnumber 3333)

Typing the passnumber 3333 on the front panel keypad enters the instrument specific setup menu. In the case of the intelligent DO system the user can set up calibration and exercise frequencies, the type of calibration and its subsequent acceptance limits.

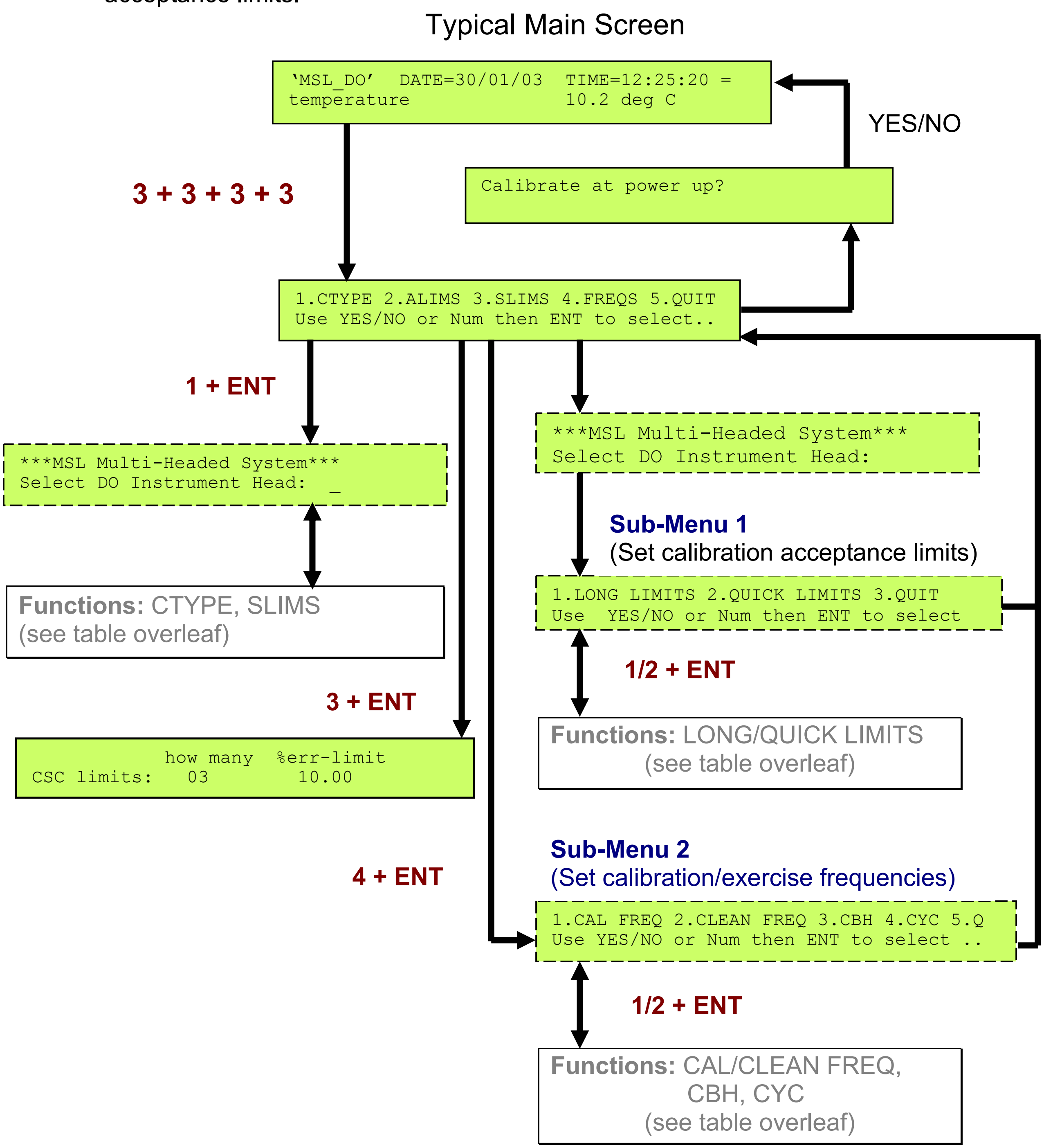


Figure 31 - Instrument-specific menu '3333' navigation flowchart

8.5.1 Functions accessed via DO instrument-specific setup menu

Instrument Specific Menu: **CYTPE, ALIMS, SLIMS, FREQS**

CTYPE	Select calibration types to use
ALIMS	**Access to Sub-menu 1**: LONG LIMITS, QUICK LIMITS
SLIMS	Calibration Statistics failure override limits
FREQS	**Access to Sub-menu 2**: CAL FREQ, EXERCISE FREQ

Sub-menu 1:	**(Set calibration acceptance limits)**
LONG LIMITS	Set long calibration sampling limits
QUICK LIMITS	Set quick calibration sampling limits

Sub-menu 2:	**(Set calibration/clean frequencies)**
CAL FREQ	Set calibration frequency in hours
CLEAN FREQ	Set clean/exercise frequency in hours
CBH	Set calibration base hour
CYC	Set calibration period cycle window size.

8.5.2 DO instrument-specific setup menu – Detailed Instructions

Typing the passnumber 3333 on the front panel keypad enters the DO instrument specific setup menu.

The user can set up and examine specific variables and functions. In the case of the DO system the user can set up calibration and clan/exercise frequencies, the type of calibration and its subsequent acceptance limits.

On entry of the valid passnumber (3333), the user will be presented with the following display:

```
1.CTYPE 2.ALIMS 3.SLIMS 4.FREQS 5.QUIT
Use YES/NO or Num then ENT to select
```

Selection of an appropriate option number will present the user with a less cryptic description on the second line. This is mainly for the casual user. Pressing ENT will select this option. This option will then drop straight into a user function or display a further sub-menu.

Please note that on entry to a menu, if DEL or ENT is pressed before selecting an option number then QUIT is always assumed and the user will be returned to the previous menu.

The following pages detail the functions available under the Instrument Specific Setup menus.

1. CTYPE – Calibration Type

On selecting **option 1** from the Instrument Specific Setup menu the user is presented with a screen similar to the one shown below:

```
**** MSL Multi-Headed System ***
Select DO Instrument Head:
```

Reference to the multi headed DO probe system will only be shown if a Multi-Headed DO System is installed.

Use the keypad to select the head required. Pressing 'ENT' will present the user with the following screen:

```
Please select calibration type…
Current CAL TYPE: LONG(32mins Approx.)
```

By pressing the 'YES' / 'NO' keys the user will be shown two further choices.

```
Please select calibration type
Current CAL TYPE: QUICK 6 mins Approx.
```

or

```
Please select calibration type…
Current CAL TYPE: QUICK if fails LONG
```

There are **two basic** types of calibration:

The standard **LONG calibration** which is where the DO System is brought to a stable 100% DO environment and the system alters its characteristics to take account of the cell's performance during this calibration sequence.

The **QUICK/SHORT calibration** is where the DO System is exposed to a shorter calibration sequence and as long as the system reaches a reproducible and acceptable cell response the system will alter is character. Please note that a LONG calibration is the recommended way to run the system. The quick calibration is for control systems that cannot afford to have the probe off line for 32 minutes, but the price to pay is that the cell must be in perfect condition to give a reliable and passable performance. This is why a third option is selectable called QUICK and LONG where the DO System will try a QUICK calibration first but if this fails to be acceptable then it will carry on to a LONG calibration.

An 'ENT' key press returns the user to the **Instrument-specific setup** menu.

2. ALIMS – Acceptance Limits

On selecting **option 2** from the Instrument Specific Setup menu the user will be presented with the following:

```
**** MSL Multi-Headed System ***
Select DO Instrument Head:  _
```

Reference to the multi headed DO probe system will only be shown if a Multi-Headed DO System is installed.

Use the keypad to select the appropriate head and press ENT to enter the following Sub-menu:

Sub-menu 1

```
1.LONG LIMITS 2.QUICK LIMITS 3.QUIT
Use YES?NO or Num then ENT to select…
```

Selection of the appropriate option number will allow the user to set the acceptance limits for the two types of calibration.

1. LONG LIMITS

This selection will result in a screen similar to the one shown below:

```
LONG LIMITS : change  diff    CV
Autocal  DO   20.00   2.000   2.000
```

'Change' This value gives the maximum permissible amount in percent (%) that the DO calibration factor will be accepted if it changes by in consecutive calibrations. In this way, calibrations that try to make too big a step change are blocked.

'**Diff'** This value gives the maximum permissible difference between the two sets of sample readings taken by the software during a calibration. In this way a calibration that is not in a steady enough state because the cell signal is still changing can be blocked.

'CV' This value represents the coefficient of variance. It is produced by dividing the standard deviation of the samples by the mean value of the samples and is used to block calibrations that have very noisy data or unusual patterns. The bigger the value the more tolerant the instrument is of bad data during calibrations and the smaller it is, the less tolerant.

The 'YES' and 'NO' key moves the cursor between the change, diff and CV fields allowing new values to be keyed in.

A 'DEL' key press returns the user to **Sub-menu 1**

2. QUICK LIMITS

This selection will display a screen similar to the one show below:

```
LONG LIMITS : change   diff   CV
autocal   DO   30.00   7.000  5.000
```

'Change' This value is the maximum permissible change (in percent (%)) in the DO calibration factor compared with the previous successful calibration that will be accepted by the software. This feature blocks dubious calibrations that try to make an unacceptably large step change compared with the previous good calibration.

'Diff' This is the maximum permissible difference between the two sets of sample readings taken for statistical analysis by the software during calibration. This feature blocks calibration where the signal has not achieved a sufficiently stable state in the allowed time – typically caused by an old, unresponsive or dirty DO cell.

'CV' This is the coefficient of variance. It is calculated by the software by dividing the standard deviation of the sample readings taken during the latter stages of the calibration cycle by the mean value of the samples. It is used to block calibrations that have very noisy data or unusual patterns. The bigger the value the more tolerant the instrument is of bad data during calibrations and the smaller it is, the less tolerant.

The 'YES' and 'NO' key moves the cursor between the change, diff and 'CV' fields allowing new values to be keyed in.

The quick limits need to be tighter particularly if the 'quick but long if quick fails' calibration type is selected. This is to make sure that the cell is giving a good response for quick limits to be valid.

A 'DEL' keypress returns the user to **Sub-menu 1.**

3. QUIT

This Selection returns to the **Instrument-specific setup** menu.

3. **SLIMS – Calibration Statistics – check Limits**

On selecting **option 3** from the Instrument Specific Setup Menu the user will be presented with a screen similar to the one shown below:

```
              how many  %err-limit
CSC limits:      03        10.00
```

The ‘YES’ / ‘NO’ keys move the cursor between the **‘how many’** and **‘%err-limit’** fields allowing new values to be keyed in.

There are circumstances when the behaviour of the sensor suddenly genuinely changes. This may be due to a change in the process and the nature of the process liquor, especially presence of trace solvents. In these circumstances, the change from one calibration to the next may exceed the normal quick or long acceptance limits (whichever are in force). Thereafter the sensor may be very stable but at a different sensitivity to what it was previously. The “CSC” feature (Calibration Statistic Check) makes provision for such events. It allows the user to set the instrument so that if a calibration changes by more than the acceptance limits set, but then the next “CSC how-many” calibrations (e.g. 3 in the example) are all within “% err limit” (e.g. 10% in the example) then accept this step change - it was genuine and reflects the new conditions.

The **‘how-many’** determines how many consecutive calibrations must fail on a **‘%diff change’** (see CAL/CAQ) with only a **‘%err-limit’** difference between these consecutive ones. If the consecutive failures meet these criteria then the failures are deemed to be reflecting that the DO sensor has changed its character but is once more exhibiting a stable character, and the calibration adjustment is allowed to take effect. The default is to have this feature turned off with **‘how-many’** set to zero, because this feature may not suit the requirements of all customers.

A ‘DEL’ key press returns the user to the **Instrument Specific Setup** menu.

4. FREQS – Calibration & Cleaning Frequencies

On selecting **option 4** from the Instrument Specific Setup menu the user will be presented with the following Sub-menu:

Sub-menu 2

```
1.CAL FREQ 2.CLEAN FREQ 3.CBH 4.CYC 5.Q
Use YES/NO or Num then ENT to select..
```

Selection of the appropriate option number will allow the user to set the calibration frequency and/or the exercise frequency of the DO system.

1. CAL FREQ – Calibration Frequency

Selecting this will display a screen similar to the one shown below:

```
Set CALIBRATION frequency in hours:
24
```

A flashing cursor prompts the entry of a new value. The new value is entered by overtyping the existing value shown and then pressing the 'ENT' or 'YES' keys.

The default setting is once every 24 hours, but can be altered between 0 and 47 (zero meaning never self-calibrate).

A 'DEL' keypress returns the user to **Sub-menu 2**.

2. CLEAN FREQ – Clean Frequency

Selecting this will display a screen similar to the one shown below:

```
Set CLEAN/EXERCISE frequency in hours:
04
```

A flashing cursor prompts the entry of a new value. Overtyping the existing value shown, and then pressing the 'ENT' or 'YES' keys inputs the new value.

The default is for once every 4 hours, but it can be altered between 0 and 23 hours (zero meaning never clean). The clean/exercise procedure is a transient event, lasting about 1 minute where the DO system operates its pneumatic piston to reduce sticking and to clean the DO cell surface to reduce organic build up.

A 'DEL' keypress returns the user to Sub-menu 2.

3.CBH – Calibration Base Hour

Selection will display a screen similar to the one shown below:

```
Set CALIBRATION base hour:
01
```

If the calibration frequency (CFQ) is set to every 24 hours (i.e. daily) then the calibration base hour is the hour from which the instrument will do its normal auto-calibration. Daily calibrations, as a fixed feature, advance their calibration point forward by one hour so that when the calibration data is inspected graphically the user has a staggered overlay for easier comprehension. In addition, it prevents the calibration from occurring at exactly the same time every day. How many hours the auto-calibration can move forward from the base hour is set by the calibration cycle window size (CYC) – see below. If the next autocalibration would fall outside this period then the calibration frequency is overridden and the auto-calibration is done at the next base hour.

For example, with calibration frequency set to 24 hours, the base hour at hour 1 and the cycle size set to 5:

On "day 1" calibration would be at 01:00
On day 2 it would be at 02:00
On day 3 it would be at 03:00
On day 4 it would be at 04:00
On day 5 it would be at 05:00
On day 6 it would revert to 01:00
On day 7 it would be at 02:00 etc.

4.CYC – Calibration Cycle Window

This selection will result in a screen similar to the one shown below:

```
Set CYCLE window in hours:
05
```

If the calibration frequency (CFQ) is set to every 24 hours (i.e. daily) then the calibration cycle window size (CYC) is used to define how many hours the auto-calibration can move forward from the calibration base hour (CBH) before the auto-calibration is forced back to the base hour. CYC defaults to 5 and can be set in the range 0 (zero) to 11 (eleven). A setting of zero is the same as setting one (i.e. the daily auto-calibration will not cycle). See also 'CBH' on the previous page

☞ A limitation of CYC is that it will not allow the cycle window to span midnight. On reaching midnight the auto-calibration will always revert back to the base hour.

5.Q
Selecting option 5 of this submenu quit will return the user to the **Instrument Specific Setup** menu.

5. QUIT

QUIT selection will exit this menu. On exit the following question will always be displayed:

```
Calibrate at power up?
```

A'YES' response forces the instrument to always calibrate on power up.
A 'NO' response will not force the instrument to calibrate on power up.

After pressing one of these, the user is will be returned to the Main Screen.

Whether this feature should be made active or not depends on user requirements. Its default is to calibrate at power up in case in the instrument has been sitting for a long period in air or in an inactive environment. This will either bring the instrument back into correct operation or highlight a fault as soon as possible.

8.6 General Setup Menu (Passnumber 1984)

Typing the passnumber 1984 on the front panel keypad enters the general setup menu. The user may alter the clock display, view and edit the parameter scaling information, specify autocalibration limits and access the I/O test/configuration menus.

The following diagram shows the key presses involved to access these functions.

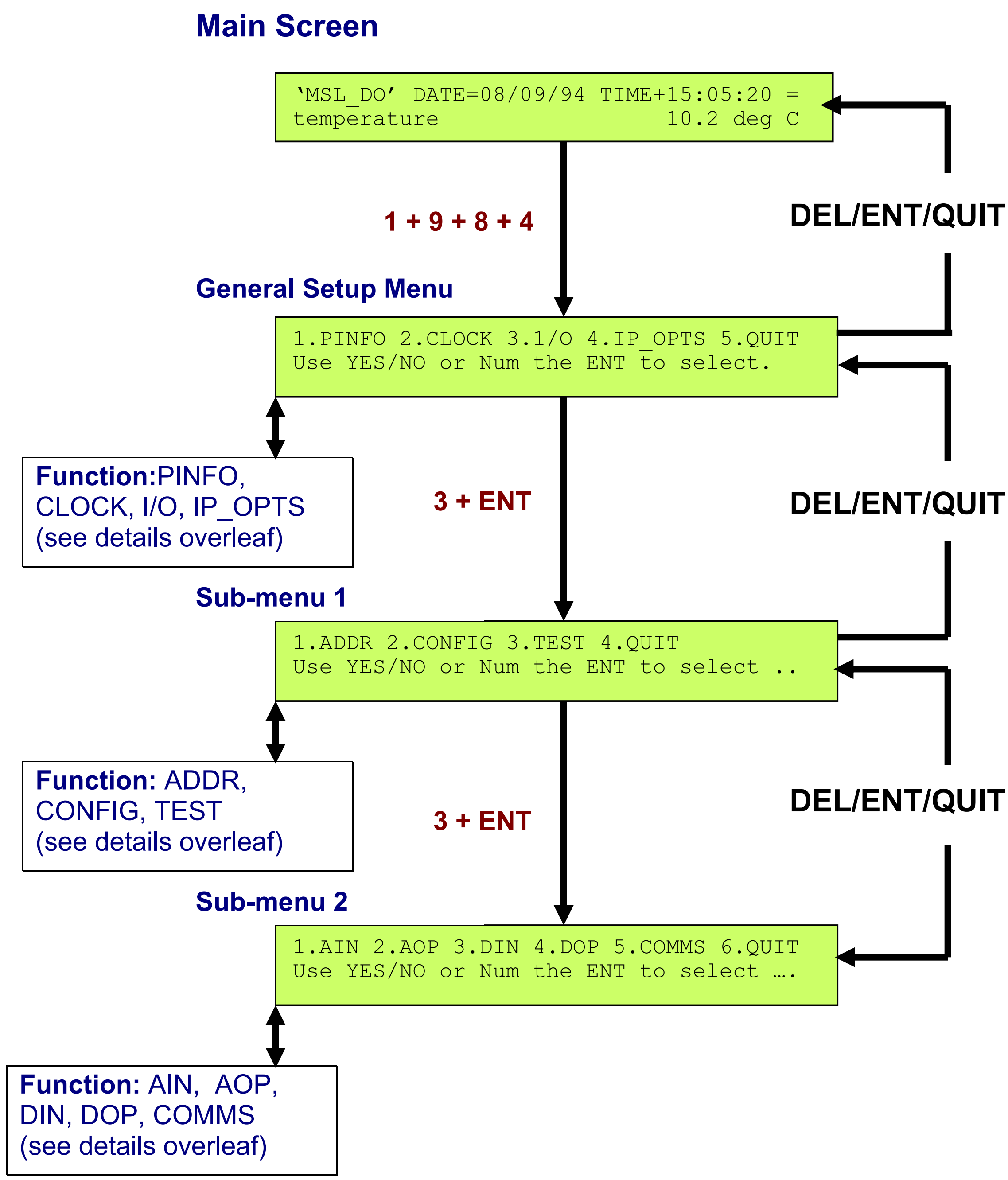


Figure 32 - General Setup '1984' menu navigation flowchart

8.6.1 Overview of functions accessed via the General Setup Menu

Main Screen Menu: PINFO, CLOCK, I/O IP_OPTS

PINFO	Re-configures the low and high scale values for the parameters being recorded.
CLOCK	Sets the system clock – required for data logging.
I/O	Access to sub-menus 1 and 1a: **ADDR, CONFIG, TEST.**
IP_OPTS	Allows user to select which parameters may be viewed on the front panel.

Sub-menu 1: ADDR, CONFIG, TEST

ADDR	Allows the instrument address to be specified
CONFIG	Configures communications ports
TEST	Access to sub-menu 1a: **AIN, AOP, DIN, DOP, COMMS.**

Sub-menu 1a: AIN, AOP, DIN, DOP, COMMS

AIN	Displays the output of the D/A converter for each configured analogue input
AOP	Allows the output of all available analogue outputs to be forced to a value entered on the keypad
DIN	Displays the status of any configured digital inputs
DOP	Allows the status of any configured digital outputs to be changed
COMMS	Sends a stream of continuous text to the configured communications port

8.6.2 General Setup Menu – Detailed Instructions

Typing the passnumber 1984 on the front panel keypad enters the general setup menu.

This menu lets the user alter the clock display, view and edit the parameter scaling information, specify autocalibration limits and access the I/O test and configuration menus.

On entry of the valid passnumber (1984) the user will be presented with the following display:

```
1.PINFO 2.CLOCK 3.I/O 4.IP_OPTS 5.QUIT
Use YES/NO or Num then ENT to select..
```

Selecting an appropriate option number will present the user with a less cryptic description on the second line of the LCD. This is provided mainly for casual users. Pressing 'ENT' will select this option. This option will then drop straight into a user function **or** display a further sub-menu.

Please note that on entry to a menu, if 'DEL' or 'ENT' is pressed before selecting an option number then 'QUIT' is always assumed and the user will be returned to the previous menu.

The following pages detail the functions available under the general setup and test sub-menus.

1. PINFO – Parameter Information

On selecting **option 1** from the General Setup Menu, the user is presented with a screen similar to the one shown below:

```
XP/In Input    {Vdc]    lsd       fsd
01/01:DO input (D)      0.000     7.000
```

This display lets the user alter the individual linear scaling that applies to each raw input signal. This is done by setting a low scale deflection ('lsd') and full-scale deflection ('fsd') in engineering units for the input shown. These values are part of the Parameter Information (PINFO) that converts the raw signal into engineering units.

Note any changes made here impinge on the analogue output if the signal in question is assigned to an analogue output.

The main reason for allowing user access to the linear scaling information is so that the 4-20 mA range of the system's configurable analogue outputs can be set to site-specific requirements. Please be aware that if a parameter is assigned to an analogue output, then 4mA will be output when the parameter value equals the 'lsd' value and 20mA when it equals the 'fsd'.

WARNING: If you alter the 'lsd' or 'fsd' you alter the correspondence of the meaning of 4mA - 20mA to any equipment monitoring the analogue output, e.g. a SCADA package, PLC etc.

You may have genuine reasons for altering the lsd and/or the fsd. For example, if an absolute DO signal (mg/l) was being passed on to a control system, then 4mA normally would represent zero but by altering the fsd to 15, 20mA would correspond to 15 mg/l instead of the system default of 10 mg/l. This type of adjustment would normally be undertaken as part of the systems commissioning.

☞

DO NOT adjust these numbers indiscriminately because some of the inputs are specifically tailored to the operation of the system.

The input name and engineering units name cannot be altered from the front panel, only via serial communications.

The 'YES' and 'NO' keys move the cursor between the lsd and fsd fields allowing new values to be keyed in. Scrolling beyond the lsd and fsd fields allows the previous or the next input to be accessed (if available).

The 'DEL' key returns the user to the **General Setup Menu.**

2. CLOCK

This provides an identical facility to the '1234' menu previously described. On initial power up the instrument will display the following message on the front panel display if the clock has not previously been set:

```
'MSL_DO'   ** PLEASE SET CLOCK **      N
temperature       10.2 deg C
```

The clock is battery-backed and therefore its setting is retained on power loss. It may require setting if the clock values drift, the battery link has been removed or the battery requires replacement.

You can change the clock settings by selecting **option 2** from the General Setup Menu. The user will then be presented with a display similar to the one shown below and may alter the date and time as required.

```
=== Clock Menu ===
13/02/2003  11:22:48
```

The date is displayed in Day/Month/Year format i.e., DD/MM/YYYY and the time in 24-hour clock format (HH:MM:SS). In the above example, the time is 48 minutes and 16 seconds past 3 in the afternoon of the 30th September 1994.

The cursor initially appears over the separation to the right of the day entry.

Please note that pressing 'DEL' immediately without making a change will take the user straight to the "**Display date/time…?**" question explained at the end of this section on the next page.

To change a value in a field **to the left** of the cursor, either press 'ENT' and then enter the new value or simply start typing a new value using the numeric keypad. When finished 'ENT' and 'YES' will accept this value and exit the field. Pressing 'DEL' will first of all delete any newly entered characters one at a time, when there are no more characters to delete the entry will be aborted and returned to its original value.

To move between fields the user must press 'YES', *to move right* and 'NO' *to move left,* **when NOT entering** (editing) the value of a field. In this way, each field can be edited by moving the cursor to the left of the field they wish to edit.

To exit press 'DEL' when not entering (editing) the value of a field and the following message will be displayed:

```
Press YES if want to update clock…
03/02/2003  11:45:14
```

If 'YES' is selected then the system will attempt to update the clock with the time and date shown. In this way, the clock can be set accurately at the press of the 'YES' key.

If the instrument detects invalid date/time values when setting the clock then the following message will be displayed for a short time (NB: Day incorrectly set to 44)…

```
Error.  clock update failed
44/03/2003  15:48:17
```

… indicating that no action was taken with the date/time settings shown. The user must now re-select the clock functions and enter the time correctly.

If ‘NO’ is selected the following message will be displayed on the screen for a short time before continuing to exit:

```
Aborted!
03/02/2003  11:45:14
```

On exit, the following question will always be displayed:

```
Display date/time on LDC top line
```

A ‘YES’ response will make the instrument display the date and time on the main screen.

A ‘NO’ response will **not** display the date and time on the top line of the main screen. In this case, the instrument will display two consecutive inputs on the main screen. The default for the instrument is to display the date and time on the top line of the main screen.

The user is now returned to the **General Setup Menu.**

3. I/O

On selecting **option 3** from the General Setup Menu the user will be presented with the first I/O (Input/Output) submenu:

<u>Sub-menu 1</u>

```
1.ADDR 2.CONFIG 3.TEST 4.QUIT
Use YES/NO or Num then ENT to select
```

Selection of the appropriate option number will allow the user to make changes that affect the communications port or allow the testing of the input/output signals on an instrument.

1.ADDR (set instrument address) selection will display a screen similar to the one shown below:

```
1.Set instrument address:
01
```

A flashing cursor prompts you to enter a new value. Enter a new value by replacing the existing value shown and then pressing the 'ENT' or 'YES' keys (sensible values are 1 to 31).

Press 'DEL' to exit the menu. If the address has been changed, the following question will be displayed:

```
Write new ADDRESS value to EEPROM?
```

(EEPROM means **E**lectrically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory. This is "non-volatile" memory that is not affected by power failures etc).

A 'YES' response retains the address on power failure; a 'NO' response uses the new address but does not retain it on power failure. (Please note that the question is asked even if the address was changed to its original value).

Pressing 'DEL' will return the user to the **General Setup Menu.**

2.CONFIG (Configure communications port) selection will display a screen similar to the one shown below:

```
CFG:COM SPEED PARITY DBITS SBITS MODE.
    0   9600   Even    7      1  Stand
```

Each instrument can use one of two available communications interfaces (ports). This display allows the user to alter the communication settings for the chosen COM port. Each field can only take a specific value or name. The 'YES' and 'NO' keys are used to move to a field and ENT is pressed to change its contents, at which point the 'YES' and 'NO' keys will now scroll between the available options. When the required option is displayed, pressing 'ENT' selects it, or 'DEL' aborts and retains the old setting.

Alternatively, when in a field an option may be chosen using a specific numeric keypress (detailed below).

Parameter	Option Selection	Numeric Keypress + ENT
COM	0	0
	1*	**1**
SPEED	300	1
(baud rate)	1200	2
	2400	3
	4800	4
	9600*	**5**
PARITY	**Even**	**1**
	Odd	2
	None	0
Dbits (Data bits)	**7***	**7**
	8	8
Sbits (Stop bits)	**1***	**1**
	2	2
MODE	**Stand (standalone)***	**1**
	Mdrop/*Mdr4W* (multidrop)	2 (4 wire - RS422)
	Mdr2W (multidrop)	3 (2 wire - RS485)
	MdPat (multidrop patch)	4

☞ *** Items marked with a star are cold start defaults.**

When not entering or editing a field, press 'DEL' to exit back to the menu.

If the user has made any changes, the following question will be displayed:

```
Write new COM PORT values to EEPROM?
```

(EEPROM means **E**lectrically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory. This is "non-volatile" memory, which is not affected by power failures etc).

A 'YES' response retains these communication settings on power failure; a 'NO' response keeps the new settings but does not retain them on power failure. Please note that the question is asked even if the communication settings were changed to their original values.

If no changes were made, the user is returned to Submenu 1.

If any changes at all have been made to the instrument address or communication settings then the following question will be displayed:

☞ **Changes will not actually take effect until after Submenu 1 has been fully exited – i.e. its option '4.Quit' has been selected and confirmed.**

```
Stop & restart COMMS task
to values just changed?
```

A 'NO' keypress will return the user to the **General Setup Menu** and the comms interface will remain unchanged.

A 'YES' keypress will produce the following response:

```
Stop & restart COMMS task
please wait…
```

then after a while…

```
Stop & restart COMMS task
please wait ……… done
```

The communications interface will now have reinitialised itself to the new settings that the user has just set. The question is asked to that the user does not need to keep switching the instrument off and on every time a series of tests or alteration are done to the interfacing during commissioning or maintenance work. In this way, the instrument's function as a DO system interfered with.

3.TEST On selecting **option 3** (test comms or boards) the user will be presented with a display similar to the one shown below:

<u>Sub-menu 1a</u>

```
1.AIN 2.AOP 3.DIN 4.DOP 5.COMMS 6.QUIT
Use YES/NO or Num then ENT to select ..
```

This menu is useful to engineers during commissioning and fault testing. It allows the user to alter/examine interface signals at a basic level to check their function.

Selecting an appropriate option number will present the user with a less cryptic description on the second line. This is mainly for casual users. Pressing ‘ENT’ will select this option. This option will then drop straight into a user function.

☞ If ‘DEL’ or ‘ENT’ is pressed before selecting an option number then ‘QUIT’ is assumed and the user will be returned to the previous menu.

The following pages detail the functions available under Sub-menu 1a:

<u>1.AIN</u> This option allows the user to examine the RAW 12-bit interface signal of an individually mapped analogue input. Selection of this option will display a screen similar to the one shown below:

```
AnaIn (Slot,Chan)   Value
  00  (   0,    0):  0 == DOxxCELL
```

The value will be the un-translated ‘raw’ value read from the ADC (Analogue Digital Converter) in the instrument’s electronics and will be a whole number between 0 and 4095. These values may only be observed. The user cannot change them. The display shows the analogue input number (‘AnaIn’) as perceived by the instrument and from which card slot and channel the reading is coming. The ‘YES’ and ’NO’ keys let the user scroll to the previous and next inputs if available.

Pressing ‘DEL’ returns the user to Sub-menu 1a.

2.AOP This allows the user to set all available analogue output levels to a fixed value during testing. Selecting this option will display a screen similar to the one shown below:

```
All AnaOUTS currently at 12mA
Enter new mA value:
```

The screen shows the current value of all available Analogue outputs. A new mA value may be entered using the whole numbers between 4 and 20 as the mA value required. Values outside this range will not be accepted. (**Note:** the new value set applies to all analogue outputs. **There is no facility to set different individual outputs to different mA values.**

Once a number has been typed, pressing 'ENT' will set all analogue outputs to this mA level. Pressing DEL while entering a number will remove the number a character at a time. If no characters are left the entry will be aborted and the analogue outputs will remain at the current value shown.

Pressing 'DEL' when not entering a number returns the user to Sub-menu 1a.

3.DIN This option allows the user to examine the state of any mapped-in digital inputs, which generally indicate a status, or control signal that the instrument needs to know about. In this way the user can check if such signals are reaching the instrument and are in the correct state.

Selection of this option will display a screen similar to the one shown below:

```
DigIN (Slot, Chan)  State
   00 (   0,     0): Off == CAL.DO
```

These values may be observed only. The display shows the digital input number (DigIN) as perceived by the instrument and which card slot and channel the signal is coming from. The YES/NO keys allow the user to scroll the previous and next inputs if available.

Pressing 'DEL' will return the user to Sub-menu 1a.

4.DOP This option allows the user to alter the state of any mapped-in digital outputs, which are generally used to control instrument options. In this way, the user can test these control operations.

The user must be aware that using this option interferes with the instrument's ability to perform its own autocalibration and cleaning functions so long as its normal states are overridden via this menu.

Selection of this option will result in display similar to the one shown below:

```
SAFETY! Please disconnect all air lines
Before handling the probe.   OK?
```

WARNING

This is a safety message to remind the user to disconnect all air lines before Removing the probe from the process otherwise the piston may cause injury if accidentally operated.

A 'NO' + 'ENT' or a 'DEL' keypress will return the user to Sub-menu 1a.

A 'YES' + 'ENT' keypress will display a further question as shown below:

```
Suspend  NORMAL OPERATION?
```

A 'NO' + 'ENT' response returns the user to **Sub-menu 1.**

If the 'YES' key is pressed the instrument is taken off line with its current DO control signals held and a screen similar to the one shown below will be displayed.

```
DigOUT Slot,  Chan)  State
   00  (  0,      0): Off == DOWN
```

This display shows the digital output number (DigOUT) as perceived by the instrument, and which card and slot the signal is coming from.

The user may now examine or test the instrument's primary control signals by using the 'YES' and 'NO' keys. The numeric values 0 or 1 may also be pressed to provide the same operations.

Once the state is as required, press 'ENT' to make the output reflect the change.

On exit the following "Resume normal operation?" question will always be asked:

```
Resume  NORMAL OPERATION?
```

A 'YES' response must be entered to return to Sub-menu 1a, otherwise the instrument will stay in the DOP menu. Once YES is entered the instrument regains control of the outputs upholds the control signals, and resumes normal operation.

5.COMMS This lets the user test the currently-configured communications port for correct transmission to remote devices (e.g. Workstations, PC's modems).

> ☞ The user must be aware that when using this feature on a live system they may interfere with other devices connected to the instrument network. **DO NOT** use this option unless it is known that the communications bus is in a static state.

Selection of this option will display a screen similar to the one shown below:

```
Press a key to stop comms test …
5:  Comms – send test text to COM Port
```

The instrument is now sending a continuous text stream to the communication port(s).

The text consists of continuously repeated pairs of lines…

COMMS TEST MESSAGE 01234567890
The quick brown lazy foxy dog
COMMS TEST MESSAGE 01234567890
The quick brown lazy foxy dog
COMMS TEST MESSAGE 01234567890
The quick brown lazy foxy dog

and so on…

Any keypress stops this transmission and returns the user to Sub-menu 1a.

6.QUIT Selection of this option returns the user to Sub-menu 1.

4.QUIT Selecting 'QUIT' + 'ENT' (in Submenu 1) returns the user to the General Setup menu unless any changes have been made to the address or communications settings. In this case, the following question will be displayed:

```
Stop & restart COMMS TASK
to values just changed?
```

A 'NO' keypress will return the user to the General Setup Menu and the comms interface will remain as it is.

A 'YES' keypress will produce the following response:

```
Stop & restart COMMS TASK
please wait …… done
```

The communications interface will now have reinitialised itself to the new settings that the user has just set. This question is asked so that the user does not need to keep switching the instrument on and off every time a series of tests or alterations are done to the interfacing during commissioning or maintenance work. In this way the instrument function as a DO system is not constantly interfered with.

☞ If the General Setup Menu has been entered as part of an installation procedure, then please carry out operational confidence checks now.

4. IP_OPTS

Selection of this option will display a screen similar to the one shown below:

```
XP/in Input  [Vdc]                DISP
01/01:d.o input (D)                y
```

This sub-menu will let you select which parameters can be inspected on the LCD.

XP/in	:	Shows the parameter's number within the Pinfo or Extended Pinfo
Inputs [units]	:	Shows the name of the input and its engineering units.
DISP		If set to 'Y' then the input is displayed on the LCD; if set to 'N' then it is not displayed.

Using the 'UP', 'DOWN', 'YES', 'NO', and 'ENT' keys in the normal way you can control which parameters can be viewed on the LCD, and if you wish, you can prevent specific parameters from being viewed, or add parameters which are not currently in the viewable list.

If you modify the list of signals that can be viewed, the new settings will take effect within a few seconds of your returning back to the main screen. You return to the main screen via the normal mechanism of quitting through each of the various sub-menus.

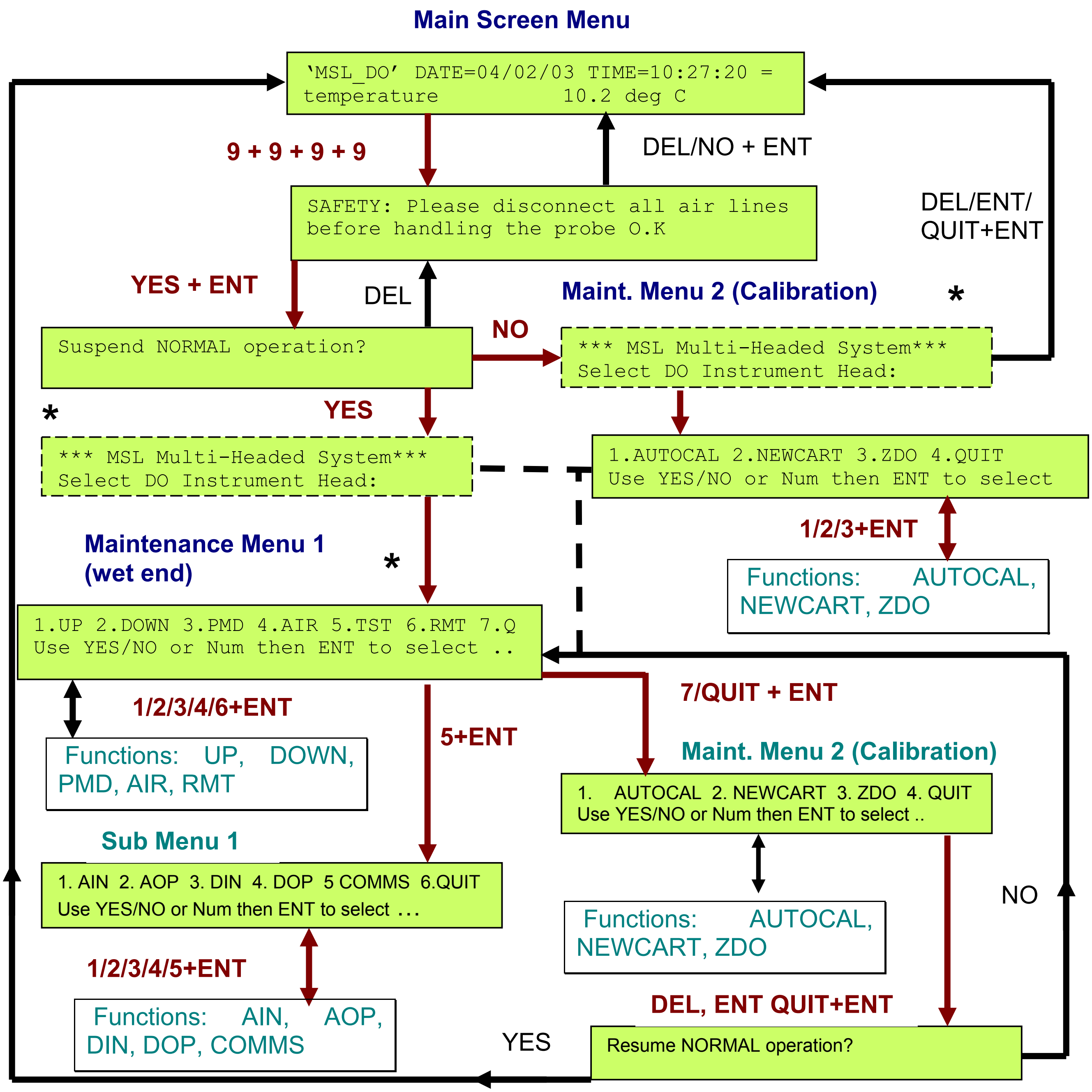
5. QUIT

On selecting **option 5** from the General Setup Menu the user will be returned to the **Main Screen**.

[Section Spacer page]

8.7 **Maintenance Menu (Passnumber 9999)**

Typing the passnumber 9999 on the front panel keypad enters this menu. The maintenance functions are accessed using this menu. It allows testing of the wet end assembly and/or setting up of the wet end assembly for calibration after maintenance. The following diagram shows how these functions may be accessed:



** Depending on the type of DO system the text surrounded by dotted lines may not actually be shown*

Figure 33 - Maintenance '9999' menu navigation flowchart

8.7.1 Overview of functions accessed via the Maintenance Menu

Maintenance Menu 1 (Wet End): UP, DOWN, PMD, AIR, TST and RMT

UP	Moves the probe up into the shroud/ball.
DWN	Moves the probe down into the process.
PMD	Sets the probe movement delay time.
AIR	Force calibration air past the DO probe assembly (maximum duration 30 minutes)
TST	Enables the user to view and test analogue and digital inputs and outputs. **Access to Sub-menu 1**: AIN, AOP, ZDO, DOP, COMMS
RMT	Enables the user to operate the UP, DOWN and AERATE functions from a (if applicable) separated local control Box.

Sub-menu 1 (I/O and comms) AIN, AOP, DIN, DOP, COMMS

AIN	Displays the output of the digital to analogue converter for each configured analogue input.
AOP	Allows the output of available analogue outputs to be forced to a value entered on the keypad.
DIN	Displays the status of any configured digital inputs.
DOP	Allows the status of any configured digital outputs to be changed.
COMMS	Sends a stream of continuous text to the configured communications port.

Sub-menu 2 (Calibration): AUTOCAL, NEWCART, ZDO

AUTOCAL	Flags that an autocalibration is to be carried out as soon as possible.
NEWCART	Recalculates calibration factors to take account of new probe
ZDO	Allows the zero of the DO sensor to be set by the user.

8.7.2 Maintenance menu – Detailed Instructions

Typing the passnumber 9999 on the front panel keypad enters this menu, which gives access to the maintenance functions. This menu allows testing of the wet end assembly and/or setting up of the wet end assembly for calibration after maintenance.

On entering a valid passnumber the user will be presented with the following question:

```
SAFETY! Please disconnect all air lines
Before handling the probe OK?
```

WARNING

N.B. This is a safety message to remind the user to disconnect all air lines before removing the probe from the process because the piston may cause injury if accidentally operated. Do not disconnect air lines if you wish only to observe the operation of the wet end in-situ.

To proceed the user must press the 'YES' key followed by the 'ENT' key. A 'DEL' or 'NO' keypress will return the user to the MAIN SCREEN.

Answering 'YES' + 'ENT' displays the question 'Suspend normal operation?":

```
Suspend NORMAL operation?
```

If the 'NO' key is pressed then the user is taken to the **Maintenance Menu 2 (Calibration)** sub-menu.

If the 'YES' key is pressed **the instrument is taken off line with its current DO signals held** and the Maintenance Menu 1 (Wet End) is displayed.

If the DO System has more than one head then the user will be presented with the following screen:

```
*** MSL Multi-Headed System ***
Select DO Instrument Head:
```

Use the keypad + 'ENT' to select the DO head to be tested, or pressing 'DEL' will abort and the end user will be asked the **"Resume…?"** question shown under 'QUIT' of the Maintenance Menu 2 section.

Maintenance Menu 1 (Wet End)

```
1.UP 2.DWN 3.PMD 4.AIR 5.TST 6.RMT 7.Q
Use YES/No or Num then ENT to select
```

Selection of the appropriate option number will allow the user to exercise and test the wet end assembly. **The REMOTE option (6) will only be available if the DO System has a Remote Control Box.** The following pages detail the functions available under this menu.

1. UP

Selection of option 1 will move the probe out of the process and into the shroud or ball. The screen will display the following message whilst this is happening:

```
Probe moving out of the process
```

Once the operation is complete, the user will be returned to the 1 (Wet End) menu.

2. DWN

Selection of option 2 will move the probe down into the process liquor. The screen will display the following message whilst this is happening:

```
Probe moving in to process
```

Once the operation is complete, the user will be returned to the 1 (Wet End) menu.

3. PMD

Selection of option 3 allows probe movement delay - the time allowed to enable the probe the move fully between up and down positions - to be altered. The default is 10 seconds.

The screen will display the following message:

```
Set movement delay (secs):
10
```

Type in the number of seconds required and then press ‘ENT’. Use ‘DEL’ to correct mistakes and to abort. This value may be site-specific and depends on the length of pneumatic air lines in use on the system. The accepted range is 5 to 30 seconds. It may be necessary to increase this value if longer lengths of tubing are employed and there is insufficient time for the piston to complete its travel in the allocated time.

4. AIR

Selection of option 4 opens the aerate valve so that the calibration air forces its way past the DO probe assembly. This will result in visible bubbles of air rising around the wet end assembly if it is installed in the process liquor.

The screen will display, a message similar to that below while this is happening:

```
Press any key to stop aeration …
Temp=18.5°C;     DO = 90.2 % sat
```

Pressing ‘ENT’ or ‘DEL’ on the front panel keypad stops the aeration and returns the user to the Maintenance Menu 1 (Wet End) menu.

> ☞ If not cancelled by the user, Aeration is stopped automatically after about 30 minutes, as if the user had pressed a key, to prevent compressor overheating / burnout.

5. TST

On selecting **option 5** (test communications or i/o boards) the user will be presented with a display similar to the one shown below:

Sub-menu 1:

```
1.AIN 2.AOP 3.DIN 4.DOP 5.COMMS 6.QUIT
Use YES/NO or Num then ENT to select ..
```

This menu is useful to engineers during commissioning and fault testing. It allows the user to alter/examine interface signals at a basic level to check their function.

Selection of an appropriate option number will present the user with a less cryptic description on the second line. This is mainly for casual users. Pressing 'ENT' will select this option. This option will then drip straight into a user function.

Please note that if 'DEL' or 'ENT' is pressed before selecting an option number then 'QUIT' is assumed and the user will be returned to the previous menu.

The following pages details the functions available under Sub-menu 1:

1. AIN This option allows the user to examine the RAW 12-bit interface signal (i.e. its un-translated value in the range 0-4095) of an individually mapped analogue input. Selection of this option will display a screen similar to the one shown below:

```
Analn  (Slot, Chan)   Value
  00   (   0,    0) : 0  == DOxxCELL
```

These values may be observed only – the user cannot change them! The display shows the analogue input number (Analn) as perceived by the instrument and which card slot and channel the reading is coming from. The 'YES' and 'NO' keys allow the user to scroll to the previous and next inputs if available.

Pressing 'DEL' will return the user to Sub-menu 1.

2. AOP This allows the user to set all available analogue output levels to a fixed value during testing. Selection of this option will display a screen similar to the one shown below.

```
All AnaOUTS currently at 12mA
Enter new mA value:
```

The screen shows the current value of all available analogue outputs. A new mA value may be entered using the whole numbers between 4 and 20 as the mA value required. Values outside this range will not be accepted.

☞ You cannot set individual outputs to individual values. The value you set will be applied to ALL the analogue outputs.

Once a number has been typed, pressing 'ENT' will set all analogue outputs to this mA level. Pressing 'DEL' while entering a number will remove the number a character at a time. If no characters are left the entry will be aborted and the analogue outputs will remain at the current value shows.

Pressing 'DEL' when not entering a number returns you to submenu 1.

3.DIN This option allows the user to examine the state of any mapped-in digital inputs that generally indicate a status or control signal that the instrument needs to know about. In this way the user can check if such signals are reaching the instrument and are in the correct state.

Selection of this option will display a screen similar to the one shown below:

```
DigIN  (Slot, Chan)      State
   00  (    0,     0)  :  Off   ==   CAL.DO
```

These values may be observed only – you cannot alter the state of a digital input from the keypad. The display shows the digital input number (DigIN) as perceived by the instrument and which car slot and channel the signal is coming from. The 'YES' and 'NO' keys allow the user to scroll the previous and next inputs if available.

Pressing 'DEL' will return the user to submenu 1.

4. DOP This option allows the user to alter the state of any mapped-in digital outputs, which are generally used to control instrument operations. In this way the user can test these control operations.

WARNING

The user must be aware that using this **DOP** option interferes with the instrument's ability to perform its own autocalibration and cleaning functions. With this facility to manually override control of an instrument's digital outputs you have total control that the native software would not normally ever allow. With some instruments it will even be possible to set them to combinations that could be unsafe or damaging. Be very aware of this and also be aware of any safety consequences – especially the danger of operating any pneumatic control digital ouputs if the air supply is connected, or switching on pumps or compressors unexpectedly.

Severn Trent Services accept no responsibility for the consequences of inappropriate manual operation of the digital outputs of an instrument.

Once this submenu is entered the instrument will have been taken off line with its current DO control signals held and a screen similar to the one shown below will be displayed.

```
DigOUT (Slot, Chan)      State
   00  (   0,     0)  :  Off  ==   DOWN
```

The display shows the digital output number (DigOUT) as perceived by the instrument, and which card and slot the signal is coming from.

The user may now examine or test the instrument's primary control signals by using the 'YES' and 'NO' keys to scroll previous and next outputs if available.

Pressing 'ENT' on the STATE field allows the user to alter the output to off or on using the 'YES' and 'NO' keys. The numeric values 0 or 1 may also be pressed to provide the same operations.

Once the state is as required, press 'ENT' to make the output reflect the change.

Pressing 'DEL' will return the user to Sub-menu 1.

6.RMT (Menu 1 wet-end) (If applicable)

Selection of option 6 – ‘RMT’ will allow the user to operate the UP, DOWN and AERATE functions from a Local Control Box situated local to a probe but remote from the main electronics assembly. The screen will display the following question:

```
Confirm, Enter Remote Mode [YES/NO]?
```

A NO response will return the user to Maintenance Menu 1.
A YES response results in the following message being displayed:

```
* REMOTE MODE * (press any key to exit)
Air Supply OFF
```

The user can now press the buttons on the local control box to operate the UP, DOWN and AERATE functions.

> ☞ The compressor button must be pressed and held down when any of the other function buttons are being operated.

The display will show the following text while the local control box compressor button is being pressed on

```
* REMOTE MODE * (press any key to exit)
Air Supply ON
```

Pressing any key will return the user back to the Maintenance Menu 1 (Wet End) menu.

7.Q (QUIT)

Pressing 'QUIT' + 'ENT', 'DEL' or 'ENT' will take the user to the Maintenance Menu 2 (Calibration) menu (AUTOCAL, NEWCART, ZDO, QUIT), which is described in the next section.

Maintenance Menu 2 (Calibration)

```
1. AUTOCAL  2. NEWCART  3 ZDO  4. QUIT
Use YES/NO or Num then ENT to select …
```

Selection of the appropriate number will allow the user to calibrate the DO probe. The following pages detail the functions available under this menu.

1.AUTOCAL

Selection of option 1 will display the following question:

```
Trigger auto-calibration?
Autocal - set flag to calibrate
```

A 'YES' response indicates that an autocalibration is required as soon as possible. If normal operation has been suspended then it will be triggered when normal operation is resumed. A 'NO' response will clear the autocalibration flag.

The user is returned to Maintenance Menu 2 (Calibration menu.

2.NEW CART

Selection of option 2 will display the following message:

```
Does the DO cartridge have a new span?
```

If the cartridge has been changed or a new membrane has been fitted then the user must offer a 'YES' response. This allows the instrument to recalculate the calibration factors to take account of the new probe characteristics. A 'NO' response will clear the new/changed flag.

The user is returned to Maintenance Menu 2 (Calibration) menu once the question has been answered.

3. ZDO

Selection of option 3 will allow the DO probe's output at zero DO to be changed and may be set, for example, using a sulphite solution. This will permit the user to physically adjust for any offset that the DO cartridge may be seeing from true zero and will be used during subsequent calibrations.

☞ Please note that setting ZDO correctly using sulphite or any other method requires removing and/or dismantling the probe assembly. This is why protective questions have been provided around the actual setting of ZDO so that control signals can be held so as not to adversely affect control systems during maintenance.

The following diagram shows the sequence of events:

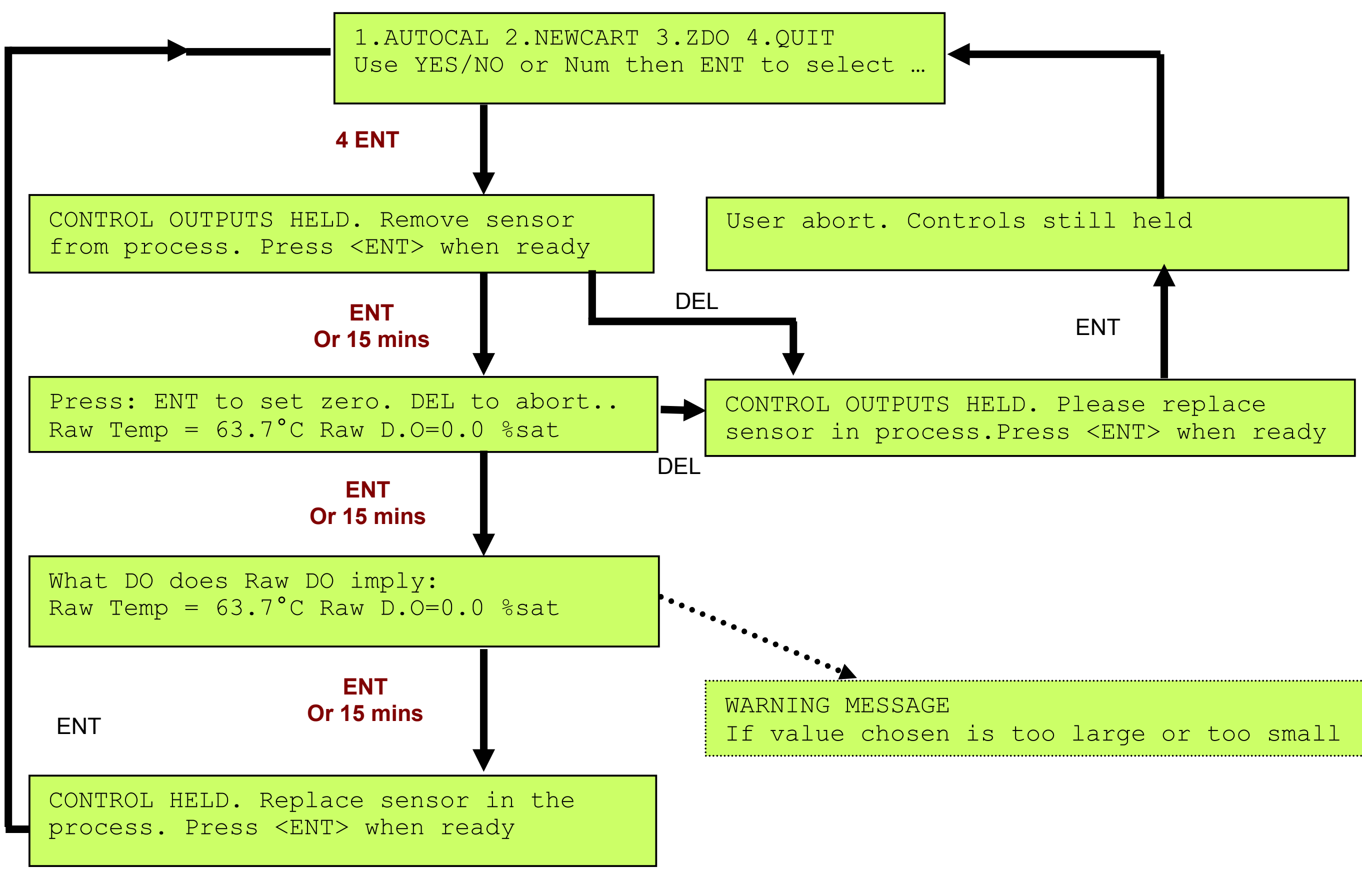


Figure 34 - Flowchart showing DO zeroing (ZDO) display sequence

It is up to the user to press the 'ENT' key when the DO shown in %Sat reaches a satisfactory/stable value. Please note that a warning message will be displayed if an unacceptable value is entered. The user will be asked to enter the value that the DO should be. Pressing 'ENT' instead of inputting a value will assume zero. If a non-zero value is entered then the system will extrapolate back to zero for the user. Values that are too large or make zero go negative will produce an error message. This will set a new value for zero DO back-calculated if necessary from the value entered by the user. The user will be returned to Maintenance Menu 2 (Calibration) menu.

4.QUIT

If the user has "suspended normal operation", due to entering Maintenance Menu 1 (UP, DWN, PMD, AIR, TST, RMT, Q) then the following question will always be displayed:

```
Resume NORMAL operation?
```

A 'NO' response will return the user to Maintenance Menu 1 (Wet End).
A 'YES' response will allow the user to exit. On exit the user returns to the MAIN SCREEN

Followed by…

```
Making sure probe is in process
```

Or, if there is more than one probe:

```
Making sure all probes are in process
```

8.8 Altitude setup menu (Passnumber 1985)

Typing the passnumber 1985 on the front panel keypad enters the altitude setup menu. It allows the user to enter the positive height in metres of the instrument above sea level.

Entering the correct passnumber will present the user with a display similar to the following:

```
Set altitude (m) above sea level:
0000
```

By typing a new number and pressing the 'ENT' key the user can change the altitude from its normal default setting of zero metres (sea level). The range for the entry is zero to 1500 metres. You can only enter whole numbers (integers). Pressing the 'DEL' key at other times will exit the menu. If you enter an out-of-range number, the entry will simply be ignored, but you will not see any error prompt. When you change an entry via the 1985 menu, it is always advisable to re-enter the menu when you have finished, just to confirm your change has 'taken'.

Altitude needs to be allowed for in all DO instruments that generate a mg/l signal. In many cases a user will not be too concerned with changing from the default of zero (sea level). However, the effect of altitude can introduce a significant error and a correction may need to be entered into the instrument. As a rough example of its effect, the correction amounts to a reduction of about 11% in DO solubility for every 1000m increase in altitude above sea level.

Useful conversion factors:

1000 feet	=	305 metres
1000 metres	=	3281 feet

☞ Please note that if you make significant changes to this value after the sensor has autocalibrated, you should force a recalibration. If the change is sufficiently large you may need to tell the instrument the DO sensor is "new", to force it to relax its calibration change checks temporarily.

8.9 Depth of Immersion Setup Menu (Passnumber 1986)

The depth of immersion setup menu is entered by typing the passnumber 1986 on the front panel keypad. It allows the user to enter the depth of immersion of the sensor at its in-situ measuring and autocalibration position in the process. Entering the correct passnumber will present the user with a display similar to the following:

```
Set depth of immersion (cm):
0020
```

By typing a new number and pressing the 'ENT' key the user can change the depth of immersion from its normal default setting of 20 cm (8 inches). The depth of immersion refers to the estimated depth below the surface of the centre of the dissolved oxygen-measuring electrode.

The range for the entry is zero to 1000 cm i.e. zero to 10 metres. You can only enter whole number (integers). Pressing the 'DEL' key will correct mistakes if the user is entering a new depth of immersion. Pressing the 'DEL' key at other times will exit the menu. If you enter an out-of-range number, the entry will simply be ignored, but you will not see any error prompt. When you change an entry via the 1986 menu, it is always advisable to re-enter the menu when you have finished, just to confirm your change has 'taken'.

Depth of immersion needs to be allowed for all in-situ autocalibrating DO instruments. In most cases, a user will not be too concerned with changing from the default of 20 (20 cm or 8 inches down). However, the effect of depth of immersion can introduce a significant error. As a rough example of its effect, if the sensor was positioned 103 cm (40") below the surface, then at auto-calibration time in-situ the air would be at an effective pressure of 1.1 atmospheres instead of 1.0 atmosphere. If this were not corrected for by keying in the actual operating/calibrating immersion depth, the actual reported DO in g/l at measurement time with the process in equilibrium with air at 1 atmosphere pressure would be 10% lower than the correct value.

Useful conversion factors:

1 foot	=	30.48 centimetres
1 metre	=	100 centimetres
1 atmosphere	=	33.9 feet of water at 4 degrees C
1 atmosphere	=	1033 cm of water at 4 degrees C
1 atmosphere	=	1.013 Bar 1013 mBar

☞ Please note that if you make significant changes to this value after the sensor has autocalibrated, you should force a recalibration. If the change is sufficiently large you may need to tell the instrument the DO sensor is "NEW", to force it to relax its calibration change checks temporarily.

8.10 Salinity Correction Setup Menu (Passnumber 1987)

The salinity correction setup menu is entered by typing the passnumber 1987 on the front panel keypad. It allows the user to enter the salinity of the medium being measured as mg/l salinity as chloride ion. This correction needs to be made if the medium contains significant amount of dissolved salts. Entering the correct password will present the user with a display similar to the following:

```
Set salinity (mg/l) as cl - :
0000
```

By typing a new number and pressing the 'ENT' key the user can change the assumed salinity from its normal default setting of zero (pure water). The salinity refers to the estimated dissolved ionic salts present, expressed as mg/l chloride ion and assumed present as sodium chloride. If the salts present are not mainly as sodium chloride, an estimate of the effective salinity needs to be input. Making this estimation is an advanced physical chemistry topic and is beyond the scope of this manual. The range for the entry is zero to 20000 mg/l as chloride (approximately 0 – 32000 mg/l as sodium chloride, or 3.2 % w/v as NaCl).

You may only enter whole numbers (integers). Pressing the 'DEL' key will correct mistakes if the user is entering a new salinity. Pressing the 'DEL' key at other times will exit the menu. If you enter an out-of-range number, the entry will simply be ignored, but you will not see any error prompt. When you change an entry via the 1987 menu, it is always advisable to re-enter the menu when you have finished, just to confirm your change has 'taken'.

Salinity may need to be allowed for in DO instruments that generate a mg/l signal. In most cases of relatively weak (in terms of salinity) domestic sewage a user will not be too concerned with changing the setting from the default of zero ('pure' water). However, the effect of salinity on dissolved oxygen solubility can be significant in industrial wastewaters or brackish or estuarine water. As a rough example of its effect, if the temperature were 20 degrees Celsius and the pressure 760 mm mercury, the saturation DO in pure water of 9.06 mg/l would be reduced to 8.19 mg/l by the presence of 10 g/l salinity (10000 mg/l or about 1.6% w/v NaCl). In this example, the error would be roughly 10% overestimation of the dissolved oxygen in mg/l if the salinity correction were not programmed into the instrument. Where salinity is constantly changing, an estimated 'typical' salinity would need to be entered, and the potential for erroneous measurements if the salinity varies much from this value will have to be understood and accepted.

Useful conversion factors:

1000 mg/l	=	1 g/l
10 g/l	=	1.0% w/v
1% w/v	=	10000 mg/l
1000 mg/l as chlorine	=	1648 mg/l as Sodium Chloride
Atomic weight Sodium	=	22.98977
Atomic wt Chlorine	=	35.4527
Molecular wt Sodium Chloride	=	58.44247

8.11 Barometric Pressure Setup Menu (Passnumber 1988)

The barometric pressure setup menu is entered by typing the passnumber 1988 on the front panel keypad. It allows the user to enter the prevailing barometric pressure. This is not often used because the pressure rises and falls spontaneously as the weather changes. However, the facility has been provided should you wish to change the pre-programmed assumed prevailing barometric pressure.

```
Set Barometric pressure mm Hg :
0760
```

By typing a new number and pressing the 'ENT' key the user can change the barometric pressure assumed by the instrument software. The range for the entry is 600 to 800 millimetres of mercury (mm Hg). The default is 760 mm Hg. You can enter whole numbers (integers). Pressing the 'DEL' key will correct mistakes if you are entering a new barometric pressure. Pressing the 'DEL' key at other times will exit the menu. If you enter on out-of-range number, the entry will simply be ignored, but you ill not see and error prompt. When you change an entry via the 1988 menu, it is always advisable to re-enter the menu when you have finished, just to confirm your intended change has 'taken'.

A fall in barometric pressure has a similar effect to a rise in altitude. Allowance can be made for it, but since it varies from day to day, falling when the prevailing weather is a low-pressure system, and rising when there is a high-pressure system, most people ignore this effect and accept the variations in accuracy it can bring about. In most cases, a user will not be too concerned with changing from the default of 760 mm Hg. Barometric pressure variations do introduce an error; as a rough example of its effect, if the pressure fell from 750 to 760 mm Hg, but the pressure drop was not compensated for, the reported mg/l figure would be high by a factor of 750/760 or just over 1% error.

Useful conversion factors:

1 atmosphere	=	760 mm Hg
1 atmosphere	=	1.01327 Bars
1 atmosphere	=	1013 mBar
1 atmosphere	=	33.9 feet of water at 4 degrees C
1 atmosphere	=	1033 cm of water at 4 degrees C

8.12 Instrument Event Menu (Passnumber 2512)

Typing the passnumber 2512 on the front panel keypad enters the instrument event menu. It allows the user to scroll up and down the internal <u>instrument dependent</u> event list, which contains event numbers with associated time stamps. At its simplest, it can be used to check if and when the instrument has had its power turned off and on. On instruments that are more complicated it provides diagnostic event numbers that allow the user to assess instrument performance and/or activities.

On entering the correct passnumber the user will be presented with a display similar to the following:

Event number   Event code   Date and Time of event

```
1]0014 05 Feb 2003, 08:50:18 |  ETS DATA
2]0009 05 Feb 2003, 08:50:18 |  > 000
```

This shows the instrument's 4-digit event numbers against a linear index. The newest event is first – at index 1. Use the 'YES' key to scroll to older events or the 'NO' key to scroll to newer events.

You can quickly move around the event number list by simply typing the event number then 'ENT'. For example if you pressed '5', then '0' then ENT the display would show event 50 as the top line. If you then pressed '1' then 'ENT' the first (latest) event would display as the top line. The instrument stores the last 99 events. Once 100 events have occurred, as each new event happens its message is put at the front of the list and the oldest one is discarded. The event display does not automatically update when a new event occurs. However, if new events have occurred since the events display was triggered, then as the user scrolls they will be indexed to the top of the list.

Pressing 'DEL' will quit this menu and return to the Main Screen.

Pressing the '.' (dot / stop / period) key will toggle display of the event number prompt. More usefully, pressing the '-' (minus) key will add an abbreviated textual event description. For example, with the display above pressing '-' would change the display to:

```
1]0014  WARM START 05 Feb 2003, 08:50:18
2]0009  POWER UP   05 Feb 2003, 08:50:18
```

Event numbers - GENERAL EVENTS (All products)

0000	"NOT SET/UNKNOWN" (meaning an event occurred which has not been given any specific description or event number)	
0009	"POWER UP"	- Power applied or re-applied to the instrument
0010	"WATCHDOG RESTART"	- A facility of the CPU – unlikely to be seen
0011	"RESTART"	- Restart request received by software
0013	"COLD START"	- A cold start – no data was retained (After power up)
0014	"WARM START"	- A warm start retains existing data (After power up)
0015	"DATE/TIME REQ"	- Request to change clock settings
0016	"DATE/TIME SET"	- Clock settings actually changed
0071	"RMESSAGING ON"	- Restricted event messaging was switched on
0072	"RMESSAGING OFF"	- Restricted event messaging was switched off

Event numbers - DO SPECIFIC EVENTS

0201	"HD 1 CALIBRATE"	- Calibration request for first DO sensor
0202	"HD 2 CALIBRATE"	- Calibration request for second DO sensor (if applicable)
0210	"HD1 CALIB OK"	- Calibration success for 1st DO sensor
0211	"HD1 XS CHANGE"	- Calibration fail level 1 for 1st DO sensor (step change too big)
0212	"HD1 LOW OUTPUT"	- Calibration fail level 2 for 1st DO sensor (signal too low)
0213	"HD1 XS NOISE"	- Calibration fail level 3 for 1st DO sensor (signal too noisy)
0214	"HD1 XS SLOPE"	- Calibration fail level 4 for 1st DO sensor (signal not stable)
0125	"HD1 XS ADJUST"	- Calibration fail level 5 for 1st DO sensor (auto factor too big/small)
0220	"HD2 CALIB OK"	- Calibration success for 2nd DO sensor (if applicable)
0221	"HD2 XS CHANGE"	- Calibration fail level 1 for 2nd DO sensor (step change too big)
0222	"HD2 LOW OUTPUT"	- Calibration fail level 2 for 2nd DO sensor (signal too low)
0223	"HD2 XS NOISE"	- Calibration fail level 3 for 2nd DO sensor (signal too noisy)
0224	"HD2 XS SLOPE"	- Calibration fail level 4 for 2nd DO sensor (signal not stable)
0225	"HD2 XS ADJUST"	- Calibration fail level 5 for 2nd DO sensor (autofactor too big/small)
0241	"HD1 MANUAL CAL"	- Manual calibration request for 1st DO sensor
0242	"HD2 MANUAL.CAL"	- Manual calibration request for 2nd DO sensor (if applicable)
0245	"COMMS MAN.CAL"	- Manual calibration request via communications port
0251	"HEAD 1 CLEAN"	- Clean request for first DO sensor
0252	"HEAD 2 CLEAN"	- Clean request for second DO sensor
0261	"HEAD 1 NEW"	- New cell request for first DO sensor
0262	"HEAD 2 NEW"	- New cell request for second DO sensor
0271	"HD1 ZDO SET"	- Zero reset for first DO sensor
0272	"HD2 ZDO SET"	- Zero reset for second DO sensor (if applicable)
0281	"HD1 USER CLEAR"	- User clear of previous request for 1st DO sensor
0292	"HD2 USER CLEAR"	- User clear of previous request for 2nd DO sensor
0291	"HD1 STATS OVRD"	- Statistics override of level 1 fail(s) for 1st DO sensor
0292	"HD2 STATS OVRD"	- Statistics override of level 1 fail(s) for 2nd DO sensor (if applicable)

The following events are only shown if restricted event messaging is turned off (communication command REM=0). The default is that event messages <u>are</u> restricted i.e. REM = 1, so these messages numbers 8010 – 9021 <u>are not</u> recorded by default.

8010	"RELAY 0 OFF"
8011	"RELAY 0 ON"
8020	"RELAY 1 OFF"
8021	"RELAY 1 ON"
8030	"RELAY 2 OFF"
8031	"RELAY 2 ON"
8040	"RELAY 3 OFF"
8041	"RELAY 3 ON"
8050	"HD1 AERATE OFF"
8051	"HD1 AERATE ON"
8060	"HD1 DOWN OFF"
8061	"HD1 DOWN ON"
8070	"HD1 UP OFF"
8071	"HD1 UP ON"
8080	"COMPRESSOR_OFF"
8081	"COMPRESSOR_ON"
8090	"DIG OUT09 OFF"
8091	"DIG OUT09 ON"
8100	"DIG OUT10 OFF"
8101	"DIG OUT10 ON"
8110	"DIG OUT11 OFF"
8111	"DIG OUT11 ON"
8120	"DIG OUT12 OFF"
8121	"DIG OUT 12 ON"
8130	"HD2 AERATE OFF"
8131	"HD2 AERATE ON"
8140	"HD2 DOWN OFF"
8141	"HD2 DOWN ON"
8150	"HD2 UP OFF"
8151	"HD2 UP ON"
8160	"DIG OUT16 OFF"
8161	"DIG OUT16 ON"
9010	"DIG IN1 OFF"
9011	"DIG IN1 ON"
9020	"DIG IN2 OFF"
9021	"DIG IN2 ON"

☞ Depending on the release of DO software controlling an instrument some or all of the preceding list may or may not be present.

A 'DEL' keypress will return the user from the'2512'menu to the Main Screen.

Remote access - PC Connection

PC access to the instrument either locally or remotely is possible using data management software packages.

Communications wiring points are shown in ***5.7.4 Data Communications*** and ***9.2 Connecting to the AZTEC DO System*** and communications commands are detailed in ***Section 9***.

It is strongly recommended that if the user wishes to take advantage of these facilities that training by Severn Trent Services staff be obtained. Serial commands allow the user to do anything that can be done using the keypad and LCD and menu system, and much more besides. Many of the features that require specialist knowledge have only been made available via serial communications to reduce the chance of users compromising the instruments function by unsuitable or accidental changes to its settings.

WARNING

INCORRECT USE OF THE SERIAL COMMANDS COULD RESULT IN INCORRECT OPERATION OF THE INSTRUMENT OR CORRUPTION OF DATA.

9 SERIAL COMMUNICATIONS

9.1 Introduction

The ***AZTEC DO System*** uses an NEC V25 16-bit processor and sophisticated software written by **Severn Trent Services** to control its operation. Many of the parameters used to determine how it carries out the various steps in its operation can be adjusted using commands sent to it over a serial communications link and **Severn Trent Services** can provide the PC 'TERMINAL' or 'Terminal 2000' program to facilitate this.

The serial communications link is also used to retrieve data using the data file transfer program ('FT') for visual inspection and the graphics viewer/manipulation program 'WINGFX' or 'GFX2000'.

Other commands can be used to adjust the way in which data is presented, outputs set up, and many other functions.

This section describes connecting to the instrument and the available commands.

9.2 Connecting to the AZTEC DO System

An RSR232 port (Port 1) and (optionally) one RS422 port (Port 0) are available on the instrument.

A 9-pin DIN plug is provided for RS232 connection to the instrument Port 1 – see below.

RS232
connection

Figure 35 - RS232 Communication connection to the Electronics Module

The connections to this plug follow standard convention i.e.

Pin 2	Tx
Pin 3	Rx
Pin 5	Signal ground

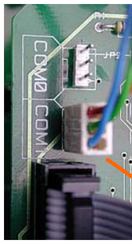
The ‘1984’ General Setup Menu ***(see page 111 section 5)*** can be used to set up the communications port. Properties that can be modified are:

- Which of the instrument’s communications port to alter;
- Speed (baud rate)
- Parity
- Number of data bits
- Number of stop bits
- The connection type.

The instrument’s communications settings and the settings to be used in the terminal emulation package (‘Terminal’ or equivalent ASCII terminal emulator) should be set to match or communications will not succeed.

The connection type is usually standalone unless several instruments are daisy-chained together, which requires that the optional extra communication module be fitted.

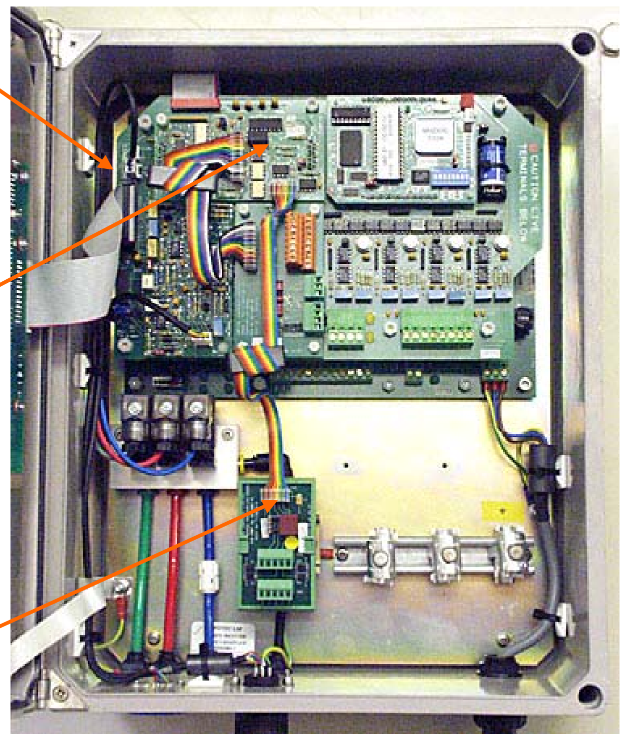
9.2.1 Location of interfaces



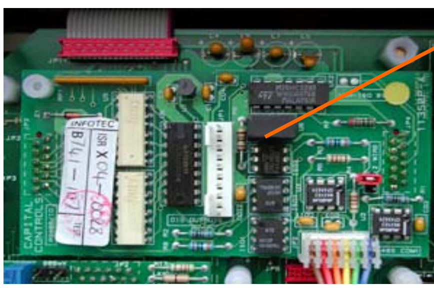
Communications port connectors on main PCB

For simple RS232 Communications COM1 is connected to the 9-pin RS232 connector on the base of the main electronics unit.

If a serial lead is used where the Tx and Rx functions are reversed, the MOLEX KK type header plug shown can simply be removed and rotated through 180 degrees before refitting. The 3-pin connector has signal ground orientated as the centre pin



Optional I/O expansion board



RS422 Terminal assembly

For instruments fitted with the optional I/O expansion module there is a terminal assembly fitted into the enclosure. Connections of field wiring for multidrop are made to the two rows of terminals as indicated. The two identical terminal strips are connected by function to their matching partners so that Tx+, Tx-, Rx+ and Rx- and signal ground each have two terminals. This enables the wire tails of the incoming data cable and outgoing data cable to have their own terminals and avoids the practice of wiring two separate tails into one terminal.

A **Termination Resistor Module** (TRM) is supplied with each I/O expansion module, but is only required to be fitted in two of the instruments in a common bus type multidrop communications network. The TRM is supplied "parked" in one row of an 8 pin dual in line (DIL) socket and in this position, the module is not in circuit. To fit the module it must first be removed and then inserted into both rows of the socket. Orientation is not important. The instruments that need the termination resistor module fitted are the two that are nearest to and furthest from the communications interface converter that is connected to the process control/remote monitoring system.

Figure 36 - Communications interface location

9.3 Remote Access

The communications port may be connected to a modem on a PSTN phone line. This enables the instrument to be interrogated remotely via the phone line without having to visit the site.

In the following explanation, this convention is used: <***return***> means perform the operation described, i.e. press the “Return Key”.

<u>Operation</u>

Having connected the cable correctly between PC and instrument, run up a suitable terminal emulation programme (e.g.Terminal).

If there is one instrument:

Type: <***return***>
<***return***>

The instrument should respond with a “?” after each <***return***>

If there is more than one instrument multidropped together then there are 2 ways of accessing a specific instrument in the chain.

MULTIDROP MODE

The first way, which we call ‘multidrop mode’, is to put the instrument address in front of every command you type. For example, see the current date set on instrument address 04 you would send:

04DAT <***return***>

and only the instrument at address 4 would reply. Note that if the address is 9 or less you must put a zero in front of its number. It can soon become tedious having to put the address at the start of the command if you wish to send a whole series of commands to the same instrument.

STANDALONE MODE

The alternative to multidrop mode is to set the instrument you are interested in to what is called ‘standalone’ mode, so that only it replies to commands sent to the loop of instruments. In effect it behaves as if it was not part of a ring but rather as if it were a standalone instrument. In this mode the other instruments on the ring are muted – they ignore commands unless they are specifically addressed towards them. To put an instrument into standalone mode you send ‘ENQ’ preceded and followed by its address. For example:

04ENQ04<***return***> (note there should be spaces in this text)

will put the instrument at address 4 into standalone mode. The instrument will reply:

ACK04
??

i.e., you will see **two** question marks echoed. From then on any command you send that does not have an address preceding it will only be acted on by the instrument that is in standalone mode. In the example, if you send:

DAT<return>

instrument 4 only will return its date setting.

But if you sent:

01DAT<return>

then the instrument at address 1 would still return its current date setting. Putting one instrument on the loop into standalone mode stops the other instrument from replying to commands if they are not preceded by the address of that instrument. If they are preceded by the address, the appropriate instrument will still reply.

Only one instrument at a time can be in standalone mode.

In the example above, if you were now to send

03ENQ03<return>

instrument 3 would go into standalone mode, and instrument 4 would revert to multidrop mode.

STANDBY MODE

It is possible to set the instrument loop back into a standby mode where **no** instrument on it is in standalone mode – they are all in multidrop mode. You do this by sending two zeros – i.e.

00<***return***>

If you do this, NO REPLY WILL BE ECHOED. You will not see anything on the terminal screen. All the instruments on the loop will go into a 'listening' mode' whereby none will reply to commands unless they are specifically sent to it by preceding the command by the appropriate address. If you send a command that is *not* preceded by an instrument address, none of the instruments will reply, because they cannot guess which instrument you are actually trying to address.

Certain programs, like the 'FT' data file transfer program, do not want all the commands they send echoed and always put the loop in standby mode when they run. Then they address each instrument by specific addressing (i.e. by always specifying the instrument address as part of a command) as they work. When they finish they leave the loop in standby mode.

You may find that you make what you believe is a valid connection to a loop instrument, and you send a command not preceded by an instrument address, but you see no reply whatsoever. If this happens it may be that somebody or some program has left the system in standby mode (which strictly speaking is good practice!). In this event always try either putting one of the instruments into standalone mode. E.g. send 01ENQ01<***return***>, or try sending a command including the address e.g. 01DAT<***return***>. If this still fails, you have some other problem, perhaps incorrect connections or wrong baud rate, parity or whatever.

Assuming the instrument is now ready to communicate using the serial commands, typing any of the available three letter codes preceded if necessary by the address and followed by <return> will normally result in a reply. See the following pages for further details.

☞ All **commands** to AZTEC instruments must be sent in **UPPER CASE.** The Terminal progam has an option to force uppercase; other terminal programs will almost certainly not force upper case.

9.4 Available serial communications commands

The following table lists the available communications commands for DO instruments. Not all are of use to the average user. Those likely to be of interest and whether they are of basic, experienced or specialist use are individually described after the table.

9.4.1 List of commands

The details given below provide a key to the layout of those of the serial commands listed in full in the subsequent text. The fields are shown in inverse text below. In the actual descriptions, they will be shown bold. The description of each field is shown italicised and in brackets below. In the actual descriptions, they will be plain text.

'XXX' Command

Command: *(XXX – brief description of command name)*

Purpose: *(Description of the purpose of the command)*

Applies to: *(which instruments)*	**User knowledge:** *(Extent of user knowledge needed)*
Type: *(Whether Read, Write or both)*	**History:** *(When issued/modified)*

Syntax:

Read :	*(Syntax of read command)*
Write :	*(Syntax of write command)*

Remarks: *(any remarks relevant to the read or write syntax)*

Example:

Read:	*(Example of read command)*
Write:	*(Example of read command)*

(*Further descriptive or explanatory information may be shown here)*

See Also: (Associated commands etc.)

Those commands that are thought likely to be of interest to the general user will now be described in detail. Some of those that are for specialist use are described. Whatever their intended audience, they should be used with caution – note the warning notice that follows. If you have any doubts or queries about any of the commands contact Severn Trent Services.

REMEMBER: Making inappropriate changes to settings via the serial communications commands or via the keypad and LCD can compromise the operation of the instrument.

The consequences of any changes made via serial communications commands or via the front panel LCD and Keypad menu system are the user's responsibility – Severn Trent Services accept no responsibility.

9.4.2 Detailed descriptions of specific comms commands

There follows detailed descriptions of selected communications ('comms') commands relevant to the DO and DO-SS family of products, sorted alphabetically.

References to MADOS in this section should be regarded in the following way:

References to MADOS V should be read as AZTEC Series 5000.

'ACT' Command

Command : ACT - Current Instrument **ACT**ivity

Purpose: Useful in diagnostics. This command instructs the instrument to transmit through the serial port and display on the LCD a message describing what it is currently doing.

Applies to:	All instruments	**User knowledge:**	Basic
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read :	ACT
Write :	ACT=message {addition message} (Where 'message' = actual text to be displayed / transmitted and additional message is only given with a tank respirometer in mode 5 (toxicity))

Remarks: Most useful in read mode, and especially so if connected remotely via the serial port. If 'ACT' is used to change the action string, the new message remains unless altered again by the user or until the instrument carries out a new action and changes the old action message itself. Therefore it is not necessarily possible to be sure that a displayed message will be on screen for long enough for an observer to notice and read it, so it is not a reliable method of sending messages to a person who may be standing looking at the display.

If the message is more than 40 characters long, any beyond the 40th character will be discarded. It is necessary to have the 'DAS', 'DTM' and 'DSP' commands set appropriately - see separate entries for these commands

Example:

Read :	?ACT Decay to stop fraction of max DO
Write :	?ACT=Any text message

The write example would result in the message "Any text message" being displayed on the top line of the display. However it would only be displayed until such time as a new action occurs for which the instrument is programmed to display an associated message. At that time the instrument will automatically replace the old message on the display, overwriting the existing message.

>> More

In addition to being displayed locally (provided ‘DAS’ and ‘DTM’ are set appropriately), the message is also transmitted via the serial port. By sending 'ACT' periodically a computer user remotely connected to an instrument via the serial port and terminal software can monitor what the instrument is doing.

The number of action messages varies with the particular instrument. Quality monitor instruments and respirometers have comprehensive messaging.

See Also: **DAS ; DTM ; DSP ; ETS ; XETS**

'AIR' Command

Command: **AIR** – "**AIR**ate" (aerate) probe

Purpose: Useful in diagnostics. This command lets you control or view the state of the software aeration request flag for an instrument. When the instrument sees this flag set (1) it will try to aerate the probe, if possible, at that point in time. If it sees it become cleared (0) and it is currently aerating it will stop.

Applies to: DO & DO-SS instruments	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read :	AIR Multihead: AIR {head}
Write :	Single head: AIR={0/1} Multihead: AIR={0/1} {head}

Remarks: Aeration of the probe is achieved by opening the aerate valve and turning the compressor on.

In a multi-head product, the head must be specified as 1 or 2.
When reading or writing from the probe a '1' means the probe is aerating and a '0' that it is not aerating.

The return value of a 1 or 0 from a read does not guarantee that the probe is currently aerating or not. Under certain circumstances such as autocalibration, or normal operation being suspended via the instrument's front panel, this flag is ignored by the instrument software. To protect the instrument against careless use a 30-minute time-out has been incorporated in the instrument's software, which prevents the probe being continuously aerated.

Example: Read –

```
?AIR
Head 1      (DO) 1
Head 2      (DO) 0
```

Here the read of the flags indicates that the instrument's aerate flag is set for head 1 of a double DO instrument. This means that the probe is aerating if it is in normal operation.

Write –

```
?AIR=1 2
```

In this example the aerate request flag is set to '1' for head 2 of a double-headed DO instrument. Thus, the instrument will start to aerate the probe if it is in normal operation.

See Also: **DWN; UP**

‘ALC’ Command

Command: **ALC** – **AL**arm **C**ount – controls sensitivity of alarms (hysteresis)

Purpose: To control the sensitivity of alarms being triggered, to minimize the chance of false triggers or triggering on transients.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	**ALC** {start} {end} ‘start' = number of the first alarm whose count is to be examined’ ‘end' = number of the last alarm whose count is to be examined’
Write:	ALC={alarm number} {count value} ‘alarm number' = the alarm number as reported by ‘PIN’ ‘count value’ = #seconds alarm condition must be present

Remarks:

Setting up a count value of zero means a change is shown as quickly as possible, desirable for example when a level sensor is triggering an action. The default at cold start is zero for all alarms.

Example:

Read:	`?ALC 1 2`
	`ALC01 0`
	`ALC02 0`

Write:	`ALC=1 2`

The read example shows the first two alarms set to trigger immediately the alarm state has been detected.

The write example shows setting the first alarm to trigger if the alarm condition has been present for 2 seconds.

See Also: **DAS; DTM; DSP; ETS; XETS**

‘ALM’ and XALM Command

Command : ALM and **XALM** – **AL**ar**M** output configuration

Purpose: A command for specialist users to set up conventional alarms using the available digital outputs using RAW input values. **Most users are likely to want to work using real world engineering units values, in which case see ‘SAL’ and ‘XSAL’.**

Local Keyboard menu accessibility:

No exactly equivalent mechanism. Serial communications feature only. However you can set up alarms using engineering units rather than raw units via the ‘8888.1’ digital outputs setup submenu – DIG_ALARS.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read :	**ALM** {start} {end} ‘start' = number of the first alarm to view ‘end' = number of the last alarm to view
Write :	ALM={alarm} {input}{type}{setpoint}{enable} ‘alarm' = Number of the alarm output to set ‘input’ = which input to use as the signal source to check, as numbered in the pinfo or extended pinfo ‘type’= what type of alarm to set up as follows… 0 = lo.1 – i.e low alarm set to 1 if breached 1 = hi.1 – i.e high alarm set to 1 if breached 2 = lo.0 – i.e low alarm reset to 0 if breached 3 = hi.0 – i.e low alarm reset to 01 if breached 4 = rt.1 – Special – Rate of change alarm, raised if breached ‘setpoint’= the value, in RAW units 0 – 4095, which if breached will result in the alarm triggering ‘enable’= a flag. If 0, the alarm is disabled - will not trigger even if the alarm is breached, if 1 it is enabled and will trigger.

Remarks:

If the input signal assigned to the alarm output reaches or goes beyond the alarm set point, that is above a high alarm or below a low alarm – and the alarm is enabled, then the alarm digital output will go to a state dictated by the {type} set when the alarm was set up.

If the 'PSF' command is used to change the scale range of a signal to which an alarm is assigned, the raw signal units as used by ALM will be automatically be changed correspondingly by the software. However, the scaled units, as used in 'SAL' will remain as they were, in real engineering units.

Example:

Read :	`?ALM 1 4`
	`ALM 01 04 (area under curve) 00 (lo.1) 0 1 <lo`
	`ALM 02 04 (area under curve) 01 (hi.1) 4095 1 <lo`
	`ALM 03 10 (conductivity ) 00 (lo.1) 0 1 >hi`
	`ALM 04 10 (conductivity ) 01 (hi.1) 20 1 >hi`
	
	`?XALM 1 4`
	`XALM 01 05 (area under curve) 00 (lo.1) 0 1 <lo`
	`XALM 02 05 (area under curve) 01 (hi.1) 4095 1 <lo`
	`XALM 03 13 (conductivity ) 00 (lo.1) 0 1 >hi`
	`XALM 04 13 (conductivity ) 01 (hi.1) 20 1 >hi`

Write :	`ALM=1 2 0 1000 1`

The 'Read' example shows firstly the result of asking for the settings of the first 4 alarms by using the 'ALM' command, then requesting the same information via the 'XALM' command. Note that the result is the same except for the signal numbering. If you use 'ALM', the number is the number in the Pinfo – accessed via the 'PIN' command. If you use 'XALM', the number is the number in the extended Pinfo – accessed via the 'XPIN' command. The two numbers are not necessarily the same. The extended pinfo is a 'kludge' that had to be introduced to break the limit of 16 analogue signals in an AZTEC instrument. This was sufficient for other instruments, but not for the respirometer, so the extended pinfo was introduced to be able to accommodate up to 32 signals. However, the maximum of 16 loggable signals only still applies.

To explain the significance of the report lines…

ALM 04 10 (conductivity) 01 (hi.1) 20 1 >hi
XALM 04 13 (conductivity) 01 (hi.1) 20 1 >hi

Would mean:

Alarm output number 4 is assigned to conductivity, which is the 10th signal in the pinfo, the 13th in the extended pinfo. It is a type 1 alarm, which means a high alarm that will go to state 1 when the high alarm level is breached. Its trigger level is set to 20 RAW units (i.e. 20/4095ths through the scale range). All four alarms are enabled (flag is '1'). The ">hi" says that at the time the example instrument was read, the actual value of the conductivity signal was at or above the alarm level assigned to high conductivity. (In a ball respirometer, which is where the example was taken from, this signal is pressed into use to detect liquid in the ball, being wired to digital input number 1).

The write example (ALM=1 2 0 1000 1) shows alarm 1 assigned to signal 2 in the normal pinfo. It is a type 0 (lo.1) alarm. It will switch on if the RAW value of the input channel drops below 1000 units – i.e. 1000/4095 through the scale range of the second signal in the pinfo.

See Also: SAL; ALC; XGAL; XGRA

'ALT' Command

Command : ALT – Instrument's **ALT**itude above sea level.

Purpose: To set up the altitude of the instrument if significantly above sea level. The altitude affects the solubility of oxygen in water and so a correction must be made if the altitude is significantly above sea level.

Local Keyboard menu accessibility:

You can set up the altitude via the '1985' – 'Altitude' setup menu.

Applies to:	All instruments with DO	**User knowledge:**	Basic
Type:	Both Read and Write	**History:**	Issued October 1996 Reissued 2000 for Mados V DO

Syntax:

Read:	ALT
Write:	ALT= altitude in metres (range 0 – 3000m)

Remarks: This command allows the dissolved oxygen measurement to be compensated for the effect of altitude. Opinion of the effect of not correcting for altitude differs but the consensus seems to be that it amounts to about 11.2% overestimation of the oxygen concentration per 1000 metres elevation and AZTEC have chosen this correction. Some sources claim as much as 13.9% error per 1000m.

Example:

Read :	`?ALT` `0`
Write :	`?ALT=1000`

The read example shows the instrument reporting no altitude correction being applied, which is the default.

The write example shows the instrument altitude being set to 1000m above sea level.

See Also: **For Series 5000 instruments: see also ATM ; DEP; SAL**

'AOP' and 'XAOP' Commands

Command : **AOP** and **XAOP** – Analogue OutPut signal configuration.

Purpose: To set up conventional analogue outputs.

Local Keyboard menu accessibility:

You can set up analogue outputs via the '8888.2' analogue outputs setup submenu – ANA_OUT.

Applies to:	All instruments	**User knowledge:**	Basic
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read :	AOP {start} {end} 'start' = number of the first output to view 'end' = number of the last output to view
Write :	AOP={output} {input} **'output'** = Number of the analogue output to set **'Input'** = which input to use as the signal source to check, as numbered in the pinfo or extended pinfo

Remarks:

Any available analogue outputs can be assigned to any of the available signals in the PIN or XPIN. The range of the output (4 – 20 mA) will be linearly related to the scale range of the signal in the pinfo or extended pinfo – i.e. its lsd to fsd.

Example:

Read :	`?AOP 1 4`
	`AOP 01 04 (area under curve)`
	`AOP 02 02 (absolute d.o.    )`
	`AOP 03 15 (last decay rate )`
	`AOP 04 03 (temperature     )`
	`?XAOP 1 4`
	`XAOP 01 05 (area under curve)`
	`XAOP 02 03 (absolute d.o.    )`
	`XAOP 03 19 (last decay rate )`
	`XAOP 04 04 (temperature     )`

Write :	`AOP=1 2`

The ‘Read’ example shows firstly the result of asking for the settings of the first 4 analogue outputs by using the ‘AOP’ command (AOP 1 4), then requesting the same information via the ‘XAOP’ command (XAOP 1 4). Note that the result is the same except for the signal numbering. If you use ‘AOP’, the number is the number in the Pinfo – accessed via the ‘PIN’ command. If you use ‘XAOP’, the number is the number in the extended Pinfo – accessed via the ‘XPIN’ command. The two numbers may be the same but are not necessarily so – iyt depends on the instrument type. The extended pinfo is a ‘kludge’, or ‘fix’, that had to be introduced to break the software’s limit of 16 analogue signals in an AZTEC instrument. This was sufficient for other AZTEC instruments, but not for the respirometer, so the extended pinfo was introduced to be able to accommodate up to 32 signals. However, the maximum of 16 loggable signals only still applies.

To explain the significance of the report lines…

```
AOP   04 03 (temperature     )
XAOP  04 04 (temperature     )
```

Would mean:

Analogue output number 4 is assigned to temperature, which is the 3rd signal in the pinfo, the 4th in the extended pinfo. It will output 4 mA for whatever the low scale range for temperature is (probably –10 DegC and 20 mA for whatever the high scale range for temperature is (probably +40 DegC).

Note: if you change the scale range of a signal assigned to an analogue output the correspondence of the 4mA output and 20 mA outputs change accordingly. They will automatically change to reflect the new scale range.

The write example (AOP=1 2) shows setting the first analogue output to reflect the scale range of the second signal in the normal pinfo.

See Also: **PIN ; XPIN; PIP; XPIP; VAL; DOP**

'APN' Command

Command : APN – Alter the instrument's **A**larm **P**ass**N**umber.

Purpose: To retrieve or set the passnumber which allows access to alarm settings via the front panel. The default is '8888'.

Local Keyboard menu accessibility:

You cannot change passnumbers except via serial communications commands.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	History:	Issued October 1996

Syntax:

Read:	APN
Write:	APN= {new passnumber}

Remarks: A number between 1000 and 9999 should be used, although smaller numbers can be used with leading zeros so there are 4 digits. The default for this passnumber is '8888'. If the passnumber is forgotten, connecting to the instrument via serial ommunications and issuing the read command 'APN' can retrieve it.

Example:

Read :	?APN 8888
Write :	?APN=4321

The read example shows the instrument reporting its current passnumber, which has not been changed from the default.

The write example shows the passnumber being changed to '4321'.

See Also: PSN; PPN; IPN

'ATM' Command

Command : ATM – ATMospheric (barometric) pressure correction

Purpose: To enter the barometric pressure surrounding the instrument location if significantly above sea level. This affects the solubility of oxygen in water. However, it varies according to the prevailing weather and the change is small, so **IT IS RARE TO CHANGE THIS FROM THE DEFAULT SETTING**

Local Keyboard menu accessibility:

You can set up the altitude via the '1988' – 'Barometric pressure' setup menu.

Applies to:	All Series 5000 DO instruments.	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued 2000 - Mados V DO

Syntax:

Read:	ATM
Write:	ATM= atmospheric pressure in mm mercury Default 760mm, accepted range 600-800mmHg

Remarks: This command fulfils the same function as the 'ATM' menu (Passnumber '1988'). It allows dissolved oxygen measurement to be corrected for the effect of barometric pressure. The error in not correcting is proportional to the difference in the prevailing barometric pressure from 760 mm Hg – i.e. if it fell to 750 mm Hg the indicated value would be 750/760ths of the real value. Because barometric pressure varies with the prevailing weather it is not usual to change the default value, but the facility is there if required.

Example:

Read :	?ATM 760
Write :	?ATM=750

The read example shows the instrument reporting no barometric pressure correction being applied, which is the default.

The write example shows the barometric pressure being set as being 750 mm Hg

See Also: ATM ; DEP; SAL

‘CAL’ Command

Command: **CAL** – **C**alibration **A**cceptance **L**imits - Set DO autocalibration pass criteria for a long autocalibration.

Purpose: A command for specialist users. Sets the statistical criteria that govern whether an instrument will accept the dissolved oxygen sensor long autocalibration or not.

Keypad equivalent access:

Via the 3333.1.2.1 INSTRUMENT-SPECIFIC - DO_OPTS – ALIMS – LONG LIMITS submenu.

Applies to: All instruments with DO.	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	CAL or CAL {head}
Write:	CAL = {change} {difference} {standard deviation} Or CAL = {change} {difference} {standard deviation} {head} Where: **change =** The maximum change between this calibration reading in air at calibration time and the last calibration in air, in % DO saturation, which will be accepted. **difference =** The maximum change in arithmetic mean of data taken around the two calibration check regions on the individual calibration curve. The bigger the difference between the two values the more the slope is still inclined. A difference of zero would mean the slope has fully flattened out. **Standard Deviation =** The maximum value for either of the two check regions on an individual calibration curve. In effect it is a measure of the acceptable ‘noise’ **head =** Needed for multiheaded DO instruments to specify to which head these settings are apply.

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Remarks: Two consecutive regions, each lasting three minutes, are analysed during the DO sensor long autocalibration, at a time when the reading would be expected to have levelled off. Statistical analyses of these two regions are made using criteria set by 'CAL' to see whether the calibration should be accepted or not.

Example:

Read :	?CAL 30.00 7.00 5.00 (status: =)
Write :	?CAL=15 2.5 2.0

The read example shows that the currently imposed acceptable setting for a long calibration allows 30% difference from last time, with the difference between the 2 slopes being 7% and the standard deviation maximum for either check area being 5.0. Only later instruments report "(status:)" and if '=' means the last calibration was OK, else '?' signifies it was not accepted.

The write example shows the calibration acceptance criteria being set for a maximum 15% difference from the last calibration accepted, with the slope being within 2% of flat at the two check points and standard deviation (noise) no more than 2.0.

The default 'CAL' setting is

20.0 2.0 2.0

See Also: CSC; CTS; CAQ; QTS; for all DO instruments
and CBH, CIA for DO instruments (not respirometer);

'CAQ' Command

Command : **CAQ** – Calibration Acceptance Quick calibration limits - Set DO autocalibration pass criteria for a quick (short) autocalibration.

Purpose: A command for specialist users. Sets or reads the statistical criteria that govern whether an instrument will accept a quick dissolved oxygen sensor autocalibration or not.

Keypad equivalent access:
Via the 3333.1.2.2 INSTRUMENT-SPECIFIC - DO_OPTS – ALIMS – QUICK LIMITS submenu.

Applies to: All instruments with DO.	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	CAQ or CAQ {head}
Write:	CAQ = {change} {difference} {standard deviation} Or CAQ = {change} {difference} {standard deviation} {head} Where: **change =** The maximum change between this calibration reading in air at calibration time and the last calibration in air, in % DO saturation, that will be accepted. **difference =** The maximium change in arithmetic mean of data taken around the two calibration check regions on the individual calibration curve. The bigger the difference between the two values the more the slope is still inclined. A difference of zero would mean the slope has fully flattened out. **Standard Deviation =** The maximum value for either of the two check regions on an individual calibration curve. In effect it is a measure of the acceptable 'noise' **head =** For multiheaded DO instruments to specify which head these settings are for.

Remarks: During the DO sensor autocalibration, at a time when the reading is expected to have levelled off, two consecutive regions, each lasting one minute, are analysed. Statistical analyses of these two regions are made using criteria set by 'CAQ' to see whether the calibration should be accepted or not.

Example:

Read :	?CAQ 5.00 1.00 1.00 (status: =)
Write :	?CAL=7 2.0 2.0

The read example shows that the current acceptable setting for a quick calibration allows 5% difference from last time, with the difference between the 2 slopes being 1% and the standard deviation maximum for either check area being 1.0. Only later (including ALL Series 5000) instruments report "(status:)" and if '=' means the last calibration was OK, else '?' signifies it was not accepted.

The write example shows the calibration acceptance criteria being set for a maximum 7% difference from the last calibration accepted, with the slope being within 2% of flat at the two check points and noise no more than 2.0.

The default 'CAQ' setting is

5.0 2.0 2.0

See Also: **CSC; CTS; CAL; QTS;** **for all DO instruments**
and CBH, CIA **for DO instruments (not respirometer);**

'CBH' Command

Command: **CBH** – <u>C</u>alibration <u>B</u>ase <u>H</u>our - Set Calibration Base hour.

Purpose: The Calibration Base Hour is the hour that the calibration is performed on the first date of its calibration cycle window, the size of which is defined by the 'CYC' command.

Keypad equivalent access:
Via the 3333.4.2.3 INSTRUMENT-SPECIFIC – FREQS - CAL/CLEAN FREQS - CBH submenu.

Applies to: All instruments with DO.	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	CBH
Write:	CBH = {Base hour} Where: Base hour = the hour of the day at which the calibration is performed on the first day of its cycle window range {00…23}

Remarks: Every day over the calibration window the probe will calibrate 1 hour later until the final day when it reverts back to the base hour. For example, with CYC set to its default of 5 days, on the first day of the cycle, with the CBH set to 1, the probe would calibrate at 01:10 hours then on the following day 02:10 hours until the fifth day when it would calibration at 05:10 hours. On the sixth day the cycle would start again and so the calibration would start at 01:10 hours. Note the 10 minutes past the hour offset in the above example is used to synchronise the calibration period more closely with the logger's daily data averaging period.

Example:

Read:	?CBH 1
Write:	?CBH=12

The read example shows the calibrations start set for 01:10 hours at night.
The write example sets the base hour to 12:00 hrs (i.e. noon)

See Also: CYC, CAL, CQA, CIA

'CFG' Command

Command : CFG – <u>C</u>on<u>F</u>i<u>G</u>uration information

Purpose: This command was included to allow the user to examine the instruments configuration from a remote terminal, when unsure what instruments are available on the site contacted.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read:	CFG
Write:	Not applicable

Remarks: When used this command returns a sequence of up to 9 numbers, the actual number varying with the product, but whose *general* format is:

1st number - Instrument type: e.g.

10000 - Dissolved Oxygen
10001 - Respirometer
10002 - Logger
10004 - Quality monitor (incl.PO4,NOx)
10007 - Ammonia monitor
10008 - Solids monitor

2nd - Size of calibration time stamp store.
3rd - Number of blocks in the detail catalogue.
4th - Size of log catalogue.
6th - Number of pinfo inputs.
7th - Size of the error catalogue.
8th - Size of the Respirometric time stamp store.
9th - Software version number.

Example:

```
?CFG
10001 90 10 28 18 200 600 14
```

See Also: DIR, VER

'CFQ' Command

Command : CFQ – <u>C</u>alibration <u>F</u>re<u>Q</u>uency

Purpose: Examine or set the frequency at which autocalibrating instruments will perform a routine planned autocalibration.

Applies to: DO and quality monitors and respirometers	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	CFQ
Write:	CFQ=*Calibration frequency*

Remarks: The interpretation of *Calibration frequency* varies with the type of instrument:

- With **DO instruments and quality monitors** it is the interval between autocalibrations in hours and can be set from zero to 47, with zero meaning never autocalibrate (not advisable).

- With **respirometers** it is the number of sample runs to perform between DO sensor autocalibrations and can be set from zero to 100 with zero meaning never autocalibrate (not advisable).

Example:

Read:	?CFQ 24
Write:	CFQ=12

In the case of a DO instrument or quality monitor the example write command would result in the sensor(s) being routinely autocalibrated every 12 hours; In the case of a respirometer, it would result in the DO sensor being autocalibrated every 12th sample run.

See Also: CAL; CAQ; CST; CTY; EFQ; QST

'CIA' Command

Command: **CIA** – **C**alibrate **I**n **A**larm – Whether to autocalibrate if an alarm is active at the time.

Purpose: Sets or clears a software flag to say if an instrument should be allowed to calibrate while any alarms conditions are active.

Keypad equivalent access:

The user is asked whether they want to allow calibrations whilst alarms are active on exiting from the '8888' menu. Note the suggested reply is 'YES'.

Applies to: All DO instruments	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	CIA
Write:	CIA={0/1} Where: 0 means calibrations are not permitted whilst an alarm is active, and 1 means they are permitted

Remarks: Can be used to restrict an instrument going off-line to calibrate itself during process problems. However – BEWARE – setting it can conceivably prevent an instrument from trying again to calibrate if one calibration has a problem that results in alarm levels being breached on return to the measurement mode - see page 100.

Example:

Read:	?CIA 1
Write:	?CIA=0

The read example shows the default – that calibrations are permitted even in alarm conditions.

The write example sets the flag to suppress calibrations when an alarm state exists.

See Also: ALM, SAL, XGAL, XGRA, CAL, CAQ, CBH

'CLB' Command

Command: **CLB** – CaLiBrate DO sensor

Purpose: This allows the status of the calibration request flag to be viewed or set.

Keypad equivalent access:

An autocalibration can be triggered from the 1234 or 9999 menus

Applies to: All DO / DO-SS	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	1 head CLB	multihead CLB {head}
Write:	1 head CLB = {0/1}	multihead CLB = {0/1} {head}

Remarks: In a multi-headed product the head must be specified. On power up the calibration flag is set to zero. When using this command in write mode no arguments are required as the flag is only cleared by the probe completing a calibration. Under the following conditions the probe will ignore a write with this command.

a) Normal operation has been suspended from the front panel
b) If the probe is being aerated via the AIR serial command.
c) The probe is already calibrating.

NB Setting this flag does not guarantee an immediate calibration - The request will be honoured when the software detects a suitable opportunity.

Example:

Read:	`?CLB` `0`
Write:	`?CLB=1 2`

In the read example the probe is not calibrating and has not received any request to do so.

The write example will request a calibration of head 2 of a multi-head DO

See Also: AIR, CLE, DWN, UP(P).

'CLE' Command

Command: **CLE** – **CLE**an DO sensor

Purpose: This allows the status of the sensor clean request flag to be viewed or set.

Keypad equivalent access:

No equivalent – comms command only

Applies to: All DO / DO-SS	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	1 head CLE	multihead CLE{head}
Write:	1 head CLE = {0/1}	multihead CLE = {0/1} {head}

Remarks: The clean cycle is only carried out if a clean/calibration is not in progress already, in which case the clean request is ignored. In a multi-headed product, the head must be specified. Under the following conditions, the probe will ignore a write with this command:

a) Normal operation has been suspended from the front panel
b) If the probe is being aerated via the AIR serial command.
c) The probe is already cleaning.

NB Setting this flag does not guarantee an immediate clean - The request will be honoured when the software detects a suitable opportunity.

Example:

Read:	?CLE 0
Write:	?CLE=1 2

In the read example, the probe is not cleaning and has not received any request to do so.

The write example will attempt to trigger a clean of head 2 of a multi-head DO

See Also: AIR, CLB, DWN, UP(P).

SEVERN TRENT SERVICES

'CSC' Command

Command : CSC – Set DO auto<u>C</u>alibration <u>S</u>tatistics <u>C</u>hecks override settings.

Purpose: A command for specialist users. It can be used to let the instrument override the normal restrictions set for acceptance of a dissolved oxygen autocalibration. It is designed to allow compensation for genuine step change in the properties of the sensor that can occasionally occur triggered by a change in process conditions.

Applies to:	All instruments with DO.	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	CSC
Write:	CSC = {stats to check} {stats limit} {cfc counter} **Where:** **Stats to check** = The number of previous consecutive statistics that will be checked. <u>Each</u> must <u>only</u> show a failure on % change i.e. the % change must be less than or equal to the value in 'stats limit'. Other failures (noise or excessive slope) will not qualify. **Stats limit** = The maximium percentage difference between current means that previous statistics must be within in order for the override to be enforced and the new changed calibration characteristics to be accepted from here on. **cfc counter** = This **optional** parameter is the maximum number of fails in a row that will result in the display of a query '?' on the LCD.

Remarks: This command was created to allow for the fact that with DO sensors sometimes there is a sudden change in the characteristics of the cell, caused maybe by some change in the process liquors – maybe some solvent of other effect – permanently altering the permeability of the membrane. The result is a drastic change in the cell output signal, which the CAL command would normally reject. However, if this change is genuine, stable and reproducible, the CSC command allows the user to set up conditions wherby such an event would be recognised and the new calibration characteristics would be accepted.

Example:

Read :	`CSC 3 10`
Write :	`CSC= 3 5 4`

The read example shows that if there are three calibration fails in a row, but they all fail only on a 10% difference or less from the last *accepted* calibration, and on nothing else then accept this calibration **despite** what the 'CAL' setting might say.

The write example shows the normal 'CAL' calibration checks will be overridden if 3 consecutive autocalibrations in a row fail, but they only fail on % change, and all are within 5% of the last accepted calibration. The last parameter says if there are four fails in a row, put the '?' on the top right of the LCD.

The default CSC setting is

0 0.00 1

The zero for the first and second parameters means 'check every DO autocalibration on its own criteria' – in effect meaning CSC will never override 'CAL'. The '1' for the third parameter means put a '?' on the right of the LCD as soon as even a single DO autocalibration fails.

See Also: CAL; CAQ; CSC also SLIM from the menu system

'CST' Command

Command : CST – DO sensor **C**alibration **ST**atistics

Purpose: A command for specialist users. Permits examination of the calibration statistics for the long calibration of a DO sensor.

Keypad equivalent access: Serial communications function only.

Applies to: All instruments with DO, including respirometers.	**User knowledge**: Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	CST {start} {end} or CST {start}{end}{head} Where: **Start** is the number of the first or only set of statistics to view **End** is the number of the last or only set of statistics to view Numbers for the statistics start at one and can go to a maximum of 16 **Head** is the head number for multiheaded DO instruments.
Write:	**Not applicable – read only**

Remarks: During the DO sensor autocalibration, at a time when the reading is expected to have levelled off, two consecutive regions, each lasting 3 minutes for long calibrations, are analysed. Statistical analyses of these two regions are made using criteria set by 'CAQ' to see whether the calibration should be accepted or not. The CST command allows the user to examine thse results of these statistical tests.

Example:

Read:	?CST 1 5 1.045 457078 95.56 0.115 95.67 0.108 95.61 95.67 1.045 0 1.041 456749 95.92 0.104 96.06 0.101 95.99 96.06 1.045 0 1.046 456518 95.47 0.114 95.60 0.107 95.54 95.60 1.045 0 1.034 456237 95.59 0.198 96.66 0.101 95.63 96.66 1.045 0 1.039 455751 96.15 0.099 96.27 0.091 96.27 96.27 1.045 0 (Note on a multi-headed instrument each line is preceded by Head 1 (D.O.) or Head 2 (D.O) as appropriate)
Write:	Not applicable

The read example needs further explanation. If we label the fields to assist in describing them, for example for the latest statistics, reported on the first line…

```
1.045 457078 95.56 0.115 95.67 0.108 95.61 95.67 1.045 0
 'a'    'b'     'c'    'd'    'e'    'f'    'g'     'h'   'i'  'j'
```

Then the meanings of the fields are as follows:

a) The calibration factor. Originally set to 1.000 by the software when the instrument is told the sensor is new. '1.045' means a 4.5% correction compared with the last accepted long calibration is currently in force.
b) The (coded) date time stamp when the calibration cycle began, to 1-minute resolution
c) The average of the first data area i.e. the first of the two three-minute areas at that part of the calibration where the response would be expected to be levelling off.
d) The standard deviation of the first data area – indicator of the amount of noise
e) The average of the second data area i.e. the second of the two three-minute areas at that part of the calibration where the response would be expected to be levelling off.
f) The standard deviation of the second data area – indicator of the amount of noise
g) The mean of the two separate 3 minute averaged readings
h) The value actually used for calibration; the value actually snapped to 100%
i) The autocalibration correction factor now in use – the signal is now being multiplied by 1.045 of what it was when the instrument was told the sensor was new
j) The calibration level of fail

    0. Did not fail – The calibration passed all the checks
    1. Failed because the percentage difference from the last successful calibration was too great.
    2. Failed because the cell output was too low – less than 20% of what it was when new.
    3. Failed because one or other standard deviation was too large. In other words, the signal was too noisy.
    4. Failed because the difference between the two sample means was too big. In other words, the DO was still rising with time – a sufficiently stable straight line had not established.
    5. Failed because the auto adjustment factor was just too big or too small. Not credible – i.e. outside what was acceptable according to the percentage change setting.
    '!' Means: No statistics to report – no head present!

In the example, no calibrations were rejected ('j' field was zero).

Note when a calibration is rejected, the first field ('a') is set to zero (0).

See Also: **CAL; CSC; CTS; CTY; QST; QTS for all DO instruments + respirometers**
and **CBH; CIA; CYC for DO instruments only**

SEVERN TRENT SERVICES

'CTS' Command

Command : CTS – DO sensor **C**alibration **T**ime**S**tamps for long calibration

Purpose: A command for specialist users. Returns the calibration factors, along with the timestamps when the calibration that occurred was a LONG calibration

Keypad equivalent access:
None

Applies to: All DO instruments + respirometers.	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	CTS {first} {last} {head, if multi-headed}
Write:	Not applicable

Remarks: The returned data follows the pattern of a floating point number, the calibration factor, and a following integer, representing the time stamp of the calibration; this will be repeated for all the data asked for. As new calibrations are carried out, the new data is inserted at the top of the list. The calibration time stamps will be listed in the order, most recent at the start of the list and oldest at the end of the list.

Example:

Read:

```
?CTS 1 5
1.003    12345
1.00676  15432
1.01     16543
1.0      16547
0.0      0
```

In this example, the time stamps 1 to 5 have been requested. Only 4 calibrations have been made so far though, as indicated by the last element having no time stamp. Note that the first calibration factor is exactly 1.0. This will always be the case where the Probe has been told it has a new cartridge. The order of the returned data is newest first – i.e. oldest last.

On a multi-head instrument, each line is preceded by Head1 (DO) or Head2 (DO) as appropriate.

See Also: CAL; CBH; CSC; CST; CTY; CYC; QST; QTS

'CTY' Command

Command : CTY - DO sensor - **C**alibration **TY**pe

Purpose: A command for specialist users. Allows the type of DO sensor autocalibration to be inspected or changed.

Keypad equivalent access:
Via the 3333.1.1 INSTRUMENT-SPECIFIC - DO_OPTS – CTYPE submenu

Applies to: All instruments with DO, including respirometers.	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	CTY
Write:	CTY= {Number} {Head if multihead} Number can be 0, 1 or 2 0 means do long calibrations always 1 means do short calibrations always 2 means do short calibrations until one fails, then do long ones

Remarks: The initial calibration (when the instrument has been told the sensor is new, or following a cold start) is always a long calibration. Subsequently the default is long calibrations for a DO instrument (CTY=0) and short calibrations for a respirometer (CTY=1). If short and long calibrations is selected (CTY=2) then short calibrations will be normally carried out, but if one fails, then the instrument will perform long calibrations.

The actual timings for long or short calibrations are governed by settings in the eeprom and if you think you have reason to change these timings you should consult AZTEC Technical Support.

Example:

Read:	?CTY Head1 (D.O.) 0 Head2 (D.O.) 1
Write:	CTY=0

The read example is reporting the instrument is set to do short calibrations on head 2 of a double headed DO, but long calibrations on head 1 – an improbable scenario! The write example is setting the calibration type to long calibrations.

See Also: CAL; CSC; CST; CTS; QST; QTS (DO instruments + respespirometers)
and CBH; CYC for DO instruments only

‘CYC’ Command

Command : CYC – DO sensor calibration time **CYC**ling

Purpose: A command for specialist users. It configures the time that calibrations occur on consecutive days in conjunction with ‘CBH’.

Keypad equivalent access: Via the 3333.1.1 INSTRUMENT-SPECIFIC - DO_OPTS – CTYPE submenu

Applies to: All DO instruments	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	CYC
Write:	CYC={size} Where:- Size= cycle calibration within the window size (0 to 11).

Remarks: The AZTEC DO, by default, advances the 24 hour calibration frequency by 1 hour within a 5 cycle window so overlaid data can display calibration peaks to better advantage and also to avoid the calibrations always taking place at exactly the same time each day. Setting zero stops this cycling.

Example:

Read:	?CYC 5
Write:	CYC=0

The read example is reporting that the calibration time will cycle 1 hour later each day until the 5th day, then revert to the base hour and so on

The write example is setting the cycles to zero, so making it that the calibration would occur the same time each day

See Also: CBH; CFQ

SEVERN TRENT SERVICES

'DAS' Command

Command : DAS – **D**isplay **A**ction **S**tring

Purpose: A command for specialist users. Lets you choose whether to display the latest action message on the top line of the LCD.

Keypad equivalent access:

No equivalent. If enabled, '.' Toggles the action string off and on.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	`DAS`

Write:	`DAS= {Number}`
	`Number can be 0, or 1`
	`0 means do not display the action string`
	`1 means do display the action string`

Remarks: This command, if set, takes precedence over any other command which affects the top line of the display, such as 'DTM'

Example:

Read:	`?DAS` `1`
Write:	`DAS=0`

The read example is reporting that the instrument is set to allow the action string to be displayed on the top line of the LCD.

The write example is setting the instrument so the action string will not be displayed on the top line of the LCD.

See Also: DTM

SEVERN TRENT SERVICES

‘DAT’ Command

Command: **DAT** – Set the instruments internal **DAT**e

Purpose: An instruction for Basic users upwards. Lets you set the date of the real time clock in the instrument. Logging will not start until the data has been set.

Keypad equivalent access:
‘1234’ – clock setting menu or ‘1984.2’ – General Setup – clock submenu.

Applies to: All instruments	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	`DAT`

Write:	`DAT=dd/mm/yy or DAT=dd/mm/yyyy`
	Where:
	`dd = day`
	`mm = month`
	`yy = year or yyyy = year (including century)`

Remarks: **NOTE: The date is entered and reported in the UK format of Day/Month/Year. This is not reconfigurable.**

It is important the date and time are set correctly if data logging is to work properly. The instrument will not perform correctly after a cold start until the date and time are set correctly.

Example:

Read:	`?DAT` `01/07/01`
Write:	`DAT=12/02/2003`

The read example is reporting that the instrument date is set to set to 1st July 2001 (01/07/01).

The write example is setting the date to 12th February 2003. The form DAT=12/02/03 would have worked just as well.

See Also: TIM; (SET)

SEVERN TRENT SERVICES

‘DCT’ Command

Command : DCT – Detail logging CaTalogue entries

Purpose: A command for specialist users. The probe maintains a catalogue of all the detail areas it has logged. This command shows the catalogue information for each of the detail areas contained in the instrument.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read :	DCT [param1] [param2] **Where:** param1 – 1st catalogue entry to be listed param2 – last catalogue entry to be listed
Write :	Not Applicable

Remarks: Currently the detail-logging catalogue contains a maximum of 16 entries. Each catalogue entry contains 5 data elements:

a. The number of points logged in the area.
b. The number of seconds between each logging.
c. The inputs that have been logged. This number is a bitmapping of the inputs, displayed as a decimal number, with bit 0 representing input 1.
d. The number of integers that the detail area occupies. This number is continuously incremented as the detail area is logged.
e. The time stamp of when the detail area was started.

Example:

```
?DCT 5 10
210 10 113 420 0
210 10 113 420 0
210 10 113 420 0
210 10 113 420 74941
210 10 113 420 75011
210 10 113 420 75240
a   b   c   d    e
```

In the example the catalogue entries for areas 5 to 10 were requested. In this example all entries have the first 4 parameters identical. It is quite possible for them to be different. This would happen if the period or number of points or the logged inputs were altered between logging different detailed areas.

See Also: DTI ; DET ; DTS ; RDT ; TRG

'DEP' Command

Command : DEP – **DEP**th of immersion

Purpose: A command for specialist users and installers. Allows Dissolved Oxygen readings to be compensated for the effect of significant depth of immersion of the sensor on the pressure of the calibrating air when in-situ auto-calibration is performed.

Keypad equivalent access:

Accessible via the '1986' menu

Applies to:	Series 5000 DO and later	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued Feb 2000

Syntax:

Read:	DEP
Write:	DEP={depth of immersion of the sensor below the surface in cm} The default is 20 cm (8"), accepted range 0 – 1033 cm.

Remarks: This command has the same function as the DEPTH menu (Passnumber '1986'). It allows Dissolved Oxygen measurement to be corrected for the effect of in-situ calibration immersed significantly below the surface. When the probe is immersed, at calibration time the calibrating air is not at atmospheric pressure. It will be at atmospheric pressure plus the hydrostatic head above the probe. If this head is significant, a correction needs to be applied. The error in not correcting will make the indicated DO reading lower than the true reading by about 1% of the true reading for each 10 cm depth of immersion. The default value is 20 cm (8 in)

Example:

Read:	?DEP 30
Write:	DEP=35

In the read example we can see that the immersion depth has been set to 30 cm.

In the write example the depth of immersion has been set to 35 cm below the surface.

See Also: ALT; ATM; SLT

'DET' Command

Command : DET – DETailed areas configuration

Purpose: A command for specialist users. Lets you set the number of data points and frequency of logging in a detailed area.

Keypad equivalent access: No equivalent

Applies to: All instruments	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	DET
Write:	DET= {size} {time} Where size = the maximum number of logged points time = interval in seconds between logged readings

Remarks: If the parameters are altered while a detailed area is currently being logged, they will not take effect until the next detailed area is triggered. TAKE CARE WHEN ASSIGNING THESE PARAMETERS – if too large an area is specified, then earlier elements in the detail catalogue will start to be erased to make room for the pending detailed area, and if not already retrieved will be lost!

Example:

Read:	`?DET` `210 10`
Write:	`DET=200 15`

The read example is reporting that the instrument is set such that each detailed area will consist of up to 210 points for each input specified in the closely-associated '**DTI**' command. Each input will be logged once every 10 seconds. This means it will last up to about 35 minutes in total. If one input is logged, it will take up 210 'cells' in the allocated storage area; if two inputs are logged, then 420 cells will be used up, and so on. There are about 16,000 cells available in total. No detail area must occupy more than 8000 cells, otherwise as soon as a new detailed area starts the one last completed will be erased to make room for it. There is a maximum of 16 detailed areas stored, even if there are still unused storage cells available.

The write example sets the detailed area to consist of 200 elements for each logged input, with a logging frequency of once every 15 seconds.

See Also: DTI; TRG (DCT; DTS; RDT)

'DIN' Command

Command : DIN – Digital INput status

Purpose: A command for specialist users. Lets you see the state of the digital inputs in the form of a bit pattern.

Keypad equivalent access:

No exact equivalent but the '1984.3.3.3' submenu "DIN – Test digital inputs" can be used to provide similar information in a much more user-friendly format.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read:	DIN
Write:	Not applicable – read only

Remarks: Used in diagnostic work to determine the current state (1 - on; 0 - off) of digital inputs. The information is presented in binary, hexadecimal and decimal. Binary is the most useful, with the rightmost bit being the first digital input; the bit one to the left of that being the second digital input and so on.

Example:

Read:	`?DIN`
	`(binary) 0001`
	`(base16) 0x01`
	`(base10) 1`
	OR
	`?DIN`
	`(binary) 0x0xxxx0xx1x`
	`(base16) 0x001`
	`(base10) 1`

The example is reporting that the instrument currently has digital input 1 'on' and 2,3 and 4 'off'. Note that the format of this command has changed at various times and in some cases was instrument-specific. For example the AZTEC respirometer reports its data in the *second* format, where in binary format the 'x' in the pattern should be ignored.

See Also: DOP

'DIP' Command

Command : DIP – **D**ual **I**nline **P**ackage switch

Purpose: A command for specialist users. Reports the settings of the DIP (DIL) switches.

Keypad equivalent access: No equivalent – visually inspect the switches locally**!**

Applies to: Series 5000 platform	**User knowledge:** Advanced
Type: Read only	**History:** Issued Feb 2000. MADOS V only

Syntax:

Read:	DIP
Write:	Not applicable

Remarks: Instruments based on the Series 5000 platform rely on DIP switch settings as well as their specific EPROM to dictate their function. The DIP switches will have been set correctly in the factory at testing time. If they are changed accidentally, or because the instrument has been deliberately reconfigured, the instrument should be cold started to ensure the new settings are read. WARNING – any logged data or modified settings will be lost! **If the DIP switches are set incorrectly the instrument will not function properly**. <u>If in any doubt about the correct DIP switch settings consult AZTEC Technical support</u>

Example:

Read:	?DIP DIP1-8: 11100000 **Meaning of DIP (DIL) Switches on Proteus board, viewed left to right** **(These designations are subject to change).** 0000 .xxx - Single DO 1000 0xxx - Single DO + 8 extra digital outputs 1000 1xxx - Single (remote) DO + 4 extra digital outputs 1100 0xxx - Single DO + 8 extra digital outputs & 2 extra analogue inputs 1100 1xxx - Single (remote) DO + 4 extra digital outputs & 2 extra analogue inputs 1110 .xxx - Double DO + 4 extra digital outputs 1101 0xxx - Single DO + MLSS + 8 extra digital outputs & 2 extra analogue inputs 1101 1xxx - Single (remote) DO + Single MLSS + 4 extra digital outputs & 2 extra analogue inputs 0101 .xxx - Single DO + MLSS + 1 extra analogue input '0' means OFF; '1' means ON; '.' means ignored; 'x' means don't care

The example read command show the switches set for a double DO instrument with 4 extra digital outputs.

See Also: CFG; VER

‘DIR’ and ‘XDIR’ Commands

Command : DIR – DIRectory; XDIR – eXtended DIRectory

Purpose: A command for specialist users. It lets you see all the serial communications commands that an instrument recognises.

Keypad equivalent access: No equivalent

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	DIR or XDIR
Write:	Not applicable – read only

Remarks: THE SPECIFIC CONTENTS OF THIS MESSAGE DEPEND ON T HE PRODUCT.

Example:

<table>
<tr><td>Read:</td><td>

```
?DIR
ACT AIR ALM ALT ATM AOP APN CAL CAP CAQ CBH CFG CFQ
CIA CLB CLE CSC CST CTS CTY CYC DAS DAT DCT DEP DET
DIN DIP DIR DOP DSP DTI DTM DTS DWN EFQ ENQ ETS FMA
FMR IPN LCT LOC LTS NEW OCT OMA OMR PIN PIP PMD PPN
PSF PSN PUN QST QTS RAW RDT REM RLG ROM RST SAL SCL
SLT SET SIT TIM TRG TXT UP  UPP VAL VER WRM ZDO

?XDIR
ACF  ALC  ALMx AOPx CED  DEB  DIRx DSPX DTIx ECO
EEP  FBD  FMAx FMRx HAL  ICD  JBU  OMAx OMRx PINx
PIPx PSFx PUNx RAWx RED  SALx SCLx TXTX VALx XFFA
XFFT XGAL XGRA XGA2 XLOG
```

XDIR is for specialist users only. Many of the extended command set commands are not documented in this manual – they are for specialist use. In case of query contact AZTEC Technical Support</td></tr>
</table>

The above example is for an AZTEC SERIES 5000 DO instrument

See Also: CFG; VER

'DOP' Command

Command : DOP – Digital OutPut status

Purpose: A command for specialist users. It lets you see the state of the digital outputs in the form of a bit pattern.

Keypad equivalent access:

No exact equivalent but the '1984.3.3.4' submenu "DOP – Test digital outputs" provides similar information in a more user-friendly format.

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	DOP
Write:	Not applicable – read only

Remarks: Used in diagnostic work to determine the current state (1 - on; 0 - off) of digital outputs. The information is presented in binary, hexadecimal and decimal. Binary is the most useful, with the rightmost bit being the first digital output; the bit one to the left of that being the second digital output and so on.

Example:

Read:	?DOP
	`(binary) 01011010`
	`(base16) 0x5A`
	`(base10) 90`
	`or`
	?DOP
	`(binary) 0101xxxxxxxxxxxxxxxxxxxx1010`
	`(base16) 0x280000A`
	`(base10) 41943050`

Remember the rightmost bit is the first digital input and the leftmost bit the last. The example is reporting that the instrument currently has digital output 1 'off'; 2 'on'; 3'off; 4 and 5 'on'; 6 'off'; 7 'on' and 8 'off'. Note that the format of this command has changed at various times and in some cases was instrument-specific. For example, early respirometers may report data in the second format, where in binary format the 'x' in the pattern should be ignored.

See Also: DIN

SEVERN TRENT SERVICES

‘DSP’ and ‘XDSP’ Commands

Command : **DSP** and **XDSP**– Select inputs permitted to be **D**i**SP**layed on the LCD

Purpose: A command for specialist users. Lets you choose which signals to allow to be displayed on the LCD, selecting them from the pinfo if using ‘DSP’ or the extended pinfo if using ‘XDSP’. You can thus limit the information that can be looked at locally.

Keypad equivalent access:

Can be largely achieved via ‘1984.4’ General setup - IP_OPTS submenu, but it is possible some of the ‘raw’ signals are only accessible via serial communications.

Applies to: All instruments	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	`?DSP`

Write:	`DSP=<+/-> {Param1} [opt 1] [opt 2] … [opt n]`
	`or`
	`XDSP=<+/-> {Param1} [opt 1] [opt 2] … [opt n]`
	
	Where
	Param 1 is the number of the first pinfo or extended pinfo input to display
	Opt 1 is the number of the optional second input to display
	Opt 2 is the number of the optional third input to display
	…
	Opt n is the number of the optional nth input to display

Remarks: The list of numbers following ‘DSP=’ or ‘XDSP=’represents the inputs that the user can access to view on the display by scrolling with the ‘ENT’ key on the front panel keypad. It is not possible to specify the order in which they are displayed. They will be displayed in the order in which they appear in the pinfo or extended pinfo.

Using the optional qualifier ‘+’, inputs can be added to extend the existing list; by using the optional qualifier ‘-’, inputs can be removed from the existing list. The example below explains further.

>> MORE

Example:

Read:	`?DSP`
	`1 2 3 4 5 6 7 8 10 11 12 13 14 15 16 17`
	`?XDSP`
	`1 2 3 4 5 6 7 8 9 13 15 16 17 18 19 20`

Write:	`DSP= 1 2 3 4 5 6 7 8 10 11 12 13 14 15 16`
	
	`DSP= +17`
	
	`XDSP= -16`

The number of the signals in the normal pinfo can be found via the 'PIN' command, and the numbering in the extended pinfo via the 'XPIN' command.

The read example is reporting that the instrument is set to allow signals 1 through 17 with the exception of input 9 to be displayed. The XDSP read command example is similar but using the number of the signals as they appear in the extended pinfo, which are not necessarily the same as in the pinfo.

The first write example is setting the instrument so inputs 1 through 16, except for input 9 displayed on the top line of the LCD. The second example says in addition to those already displayable, add the signal 17th in the pinfo to the list. The third example says to remove the 16th signal as it appears via the XPIN command from the list of those already displayable.

If you ask to add a signal which does not exist or remove one not in the list your request will just be ignored.

See Also: DTM; DAS; PIN; XPIN

'DTI' and 'XDTI' Commands

Command : DTI, XDTI – Select **Deailed** logging **I**nputs

Purpose: A command for specialist users. Lets you choose which signals to allow to be logged into the detailed logging area, selecting them from the pinfo if using 'DTI' or the extended pinfo if using 'XDTI'. You can thus control the information that is detailed, and control the trade-off between the number of signals logged and the size and number of logged detailed areas.

Keypad equivalent access:

Can be largely achieved via '1984.4' General setup - IP_OPTS submenu, but it is possible some of the 'raw' signals are only accessible via serial communications.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:

```
 ?DTI
or
 ?XDTI
```

Write:

```
DTI=<+/-> {Param1} [opt1] [opt2] … [opt n]
or
XDTI=<+/-> {Param1} [opt1] [opt2] … [opt n]

Where
Param1 is the number of the first pinfo or extended pinfo input to detail log
Opt1  is the number of the optional second input to detail log
Opt2  is the number of the optional third input to detail log
…
Opt n  is the number of the optional 'nth' input to detail log
```

Remarks: The list of numbers following 'DTI=' or 'XDTI='represents the inputs that the user can cause to be included in a detail data log file. It is not possible to specify the order in which they are logged. They will always be logged in the order in which they appear in the pinfo or extended pinfo.

Using the optional qualifier '+', inputs can be added to extend the existing list and by using the optional qualifier '-', inputs can be removed from the existing list. The example below explains further.

>> MORE

Example:

Read:	?DTI 1 2 4 ?XDTI 1 2 5
Write:	DTI= 1 2 3 6 7 DSP= +4 XDSP= -7

The number of the signals within the normal pinfo can be found via the ‘PIN’ command, and the numbering within the extended pinfo via the ‘XPIN’ command.

The read example is reporting that the instrument is set to log signals 1, 2 and 4 in the detailed area. The XDTI read command example is similar but using the number of the signals as they appear in the extended pinfo, which are not necessarily the same as in the pinfo.

The first write example is setting the instrument so inputs 1,2,3,6 and 7 are logged in the detail area. The second example says in addition to those already displayable, add the signal 4^{th} in the pinfo to the list. The third example says to remove the 7^{th} signal as it appears via the ‘XPIN’ command from the list of those already displayable.

If you ask to add a signal which does not exist or remove one not in the list your request will be ignored.

See Also: DSP; XDSP; XLOG; PIN; XPIN

'DTM' Command

Command : DTM – Display of **D**a**T**e and **T**ime

Purpose: A command for specialist users. It lets you choose whether to display the date and time on the top line of the LCD.

Keypad equivalent access:

Setting the clock via the '1234' or 1984.2 – Clock submenu results in you being asked whether to display the date and time as you exit the menu.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	DTM
Write:	DTM= {Number} Number can be 0, or 1 0 means do not display the date and time 1 means do display the date and time

Remarks: This command, if set, is overridden by other commands which affect the top line of the display, such as 'DAS'

Example:

Read:	?DTM 1
Write:	DTM=0

The read example is reporting that the instrument is set to allow the date and time to be displayed on the top line of the LCD.

The write example is setting the instrument so the date and time will not be displayed on the top line of the LCD.

See Also: DAS

‘DTS’ Command

Command : DTS – Detailed areas TimeStamps

Purpose: A command for specialist users. Returns the timestamps when the requested detailed area(s) occurred.

Keypad equivalent access: None

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	DTS {Param1} [Param2] Where – Param1 = First catalogue entry number to see time stamp Param2 = Optional end of range of detail area log catalogue
Write:	Not applicable

Remarks: This command has the same format as ‘DCT’ but returns only as a subset of the information (namely the time stamps) all on 1 line. It is primarily used by AZTEC File Transfer software (FT).

Example:

Read:	`?DTS 5 10` `0 0 0 74941 75011 75240`

The example here is an enquiry for entries 5 through to 10 where catalogue entries 5, 6 and 7 are empty and 8, 9 and 10 contain data.

See Also: DTI; DET; DCT; RDT;TRG

SEVERN TRENT SERVICES

'DWN' Command

Command : DWN – Put probe **DoWN** into the process

Purpose: Used to monitor and/or control the DO cartridge down request flag

Keypad equivalent access: Can also be accomplished via the 9999.1 maintenance menu

Applies to:	All instruments	**User knowledge:**	Basic
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	1 head DWN	multihead DWN{head}
Write:	1 head DWN={0/1}	multihead DWN={0/1}{head}

Remarks: Remember the safety warnings about the possible danger of the power of pneumatically actuated probe movements.

Setting this flag does not guarantee that the cartridge will actually go down in the ball or shroud. If the instrument operation has been suspended from the front panel, this flag is ignored. During an autocalibration this flag is ignored too. Assuming the flag is not being ignored, it remains set until the cartridge is fully down and is then cleared. If the flag is being ignored, then eventually it will be cleared by the probe anyway. In a multi-headed product the head must be specified.

Example:

Read:	`?DWN` `0`
Write:	`?DWN=1   2`

The read example is reporting that the DWN flag is not set

The write example is setting the instrument so the DWN flag is set i.e. a request for the probe to move down is sent for head 2 of a multihead DO

See Also: AIR; UP(P)

SEVERN TRENT SERVICES

'EEP' Command

Command: **EEP – EEPROM contents**

Purpose: A command for specialist users. It can be used to look at or modify the contents of the standard 256-word EEPROM in an AZTEC instrument based on the Infotec platform hardware.

Keypad equivalent access:
No keyboard equivalent – a serial communications command feature only.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	EEP {WORD ADDRESS1} {WORD ADDRESS2}
Write:	EEP={WORD ADDRESS} {VALUE}

Remarks:

EEPROM contents are generally product specific. If used at all the likely addresses of interest would be…

EEP 0 holds the instrument address when on a multidrop loop; EEP 1 holds communications setup information – baud, parity etc.; EEP 2 holds information about the SS and/or DO sensor type. Contact AZTEC Technical Support for information about other EEPROM location functions.

WARNING: **Never write to EEP unless you know what you are doing. If you are not a Severn Trent Services employee or agent, it is probable that you should never be using the EEP command. You WILL compromise the operation of the instrument and any process controlled by it by entering inappropriate values!**

Example:

Read:	`?EEP 0 2`
	`000: 0x0001 (1)`
	`001: 0x1554 (5444)`
	`002: 0xFF02 (65282)`

Write:	If you do not know how to do this, you probably should not be doing it! Contact AZTEC Technical support for instructions on how to change EEPROM contents.

See also: [n/a]

'EFQ' Command

Command: **EFQ – E**xercise **F**re**Q**uency (cleaning frequency)

Purpose: This allows the user to inspect or change the exercise (cleaning) frequency of the piston on a DO or SS or respirometer instrument. (NOTE the command 'CFQ' has been used already for calibration frequency, hence 'EFQ' for this function).

Keypad equivalent access:

Via the instrument-specific menu 333.4.2 – CLEAN FREQ

Applies to: DO & SS & RESP	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	EFQ
Write:	EFQ={ number of hours between exercise/clean }

Remarks:

The acronym 'CFQ' has already been used for Calibration Frequency, so 'EFQ' was chosen for this function. Setting the frequency to zero disables the auto cleaning. If a multi-headed instrument, the frequency applies to each head – they cannot be configured independently.

Example:

Read:	`?EFQ` `4`
Write:	`EFQ=2`

The read example shows the cleaning (exercise) frequency set to 4-hourly – the default setting. The write example shows this being changed to 2-hourly.

See also: CFQ

'ENQ' Command

Command: **ENQ –** instruct an instrument on a multidrop loop to enter standalone mode

Purpose: This instruction for advanced users provides a mechanism for easy communications with any particular instrument on a multidrop loop.

Keypad equivalent access:
No keyboard equivalent – serial communications command feature only.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Write only	**History:**	Issued October 1996

Syntax:

Read:	Not applicable
Write:	{instrument address}ENQ{instrument address} Where instrument address is the address of the instrument to be put into standalone mode

Remarks:

The address must be a two-digit number between 01 and 15. If the address is less than 10 then a leading zero must be prepended to the entered address, thus address '1' becomes '01'. Putting any particular instrument into standalone mode makes that instrument only reply to commands sent into the loop. If an instrument is not in standalone mode, all commands destined for it must be preceded by its address. To place all instruments in a loop so none are in standalone mode, send '00'. Note that with instruments in this mode, no commands sent to the loop will be echoed, because they are ALL in listening mode.

Example:

Write:	`?15ENQ15`
	` ACK15`
	`??`

The write example sets instrument 15 into standalone mode. Note the first line of the above example (15ENQ15) will not be echoed to the terminal screen type as you type it.

See also: [n/a]

SEVERN TRENT SERVICES

‘ETS’ and ‘XETS’ Commands

Command : ETS – Examine the time-stamped events list
XETS – Examine the extended time-stamped events list

Purpose: To allow the user or service engineer to examine a list of significant events in the operation of the instrument in time stamped chronological order.

Local Keyboard menu accessibility:
The ‘2512’ menu provides a similar facility

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read :	ETS {newest event number} {oldest event number} Or XETS {newest event number} {oldest event number} Where ‘event number’ can be from 1 (newest) to 99 (oldest)

Remarks:

These useful commands permit examination of the recent history of operation of an instrument. Instruments store the last 99 events in a rotating buffer. Event number 1 is always the most recent event and event number 99 the oldest event. The actual events that are logged depend on the specific instrument and you should refer to the specific manual for details. ‘ETS’ reports in a more cryptic format with coded event numbers and coded timestamps. ‘XETS’ provides a short description of the event type and a fully parsed event date/time.

Example:

<table>
<tr><td>Read:</td><td><pre>?ETS   1   6
0220 16081944
0202 16080269
0210 16079875
0201 16078200
0251 16077600
0252 16074000
?
?XETS   1   6
26 May, 03:12:24 (0220) HD2 CALIB OK
26 May, 02:44:29 (0202) HD2 CALIBRATE
26 May, 02:37:55 (0210) HD1 CALIB OK
26 May, 02:10:00 (0201) HD1 CALIBRATE
26 May, 02:00:00 (0251) HEAD 1 CLEAN
26 May, 01:00:00 (0252) HEAD 2 CLEAN</pre></td></tr>
<tr><td>Write:</td><td>Not applicable</td></tr>
</table>

The above example shows the operation of this command where the latest six event numbers and time stamps are shown. Examples for normal and extended event time stamps are shown. The ‘XETS’ command replaces the cryptic event numbers and timestamps with short textual descriptions of the event and the true decoded date and time.

A selection of the message number codes used by (**X**)**ETS** for dissolved oxygen instruments is given below. Please note that these are a subset of the full range of possible messages on AZTEC instruments. They are subject to change and not all messages are available on all instruments.

<u>GENERAL EVENTS</u> (All products)

0000	“NOT SET/UNKNOWN	(meaning an event occurred which has not been given a specific description or event number)
0009	“POWER UP”	
0010	“WATCHDOG RESTART	
0011	“RESTART”	- Restart request
0013	“COLD START”	- (After power up)
0014	“WARM START”	- (After power up)
0015	“DATE/TIME REQ”	- Request to change clock settings
0016	“DATE/TIME SET”	- Clock settings changed
0071	RMESSAGING ON”	- Restricted event messaging on
0072	“RMESSAGING OFF”	- Restricted event messaging off

<u>DO SPECIFIC EVENTS</u> (‘XETS’ format & some event numbers supported in Series 5000 only; some only apply to double-DO instruments)

0201	“HD 1 CALIBRATE”	- Calibration request for first DO sensor
0202	“HD 2 CALIBRATE”	- Calibration request for second DO sensor
0210	“HD1 CALIB OK”	- Calibration success for 1^{st} DO sensor
0211	“HD1 XS CHANGE”	- Calibration fail level for 1^{st} DO sensor (step change too big
0212	“HD1 LOW OUTPUT”	- Calibration fail level 2 for 1^{st} DO sensor (signal too low)
0213	“HD1 XS NOISE”	- Calibration fail level 3 for 1^{st} DO sensor (signal too noisy)
0214	“HD1 XS SLOPE”	- Calibration fail level 4 for 1^{st} DO sensor (signal not stable)
0215	“HD1 XS ADJUST”	- Calibration fail level 5 for 1^{st} DO sensor (autofactor too big/small)
0220	HD2 CALIB OK”	- Calibration success for 2^{nd} DO sensor
0221	“HD2 XS CHANGE”	- Calibration fail level 1 for 2^{nd} DO sensor (step change too big)
0222	HD2 LOW OUTPUT”	- Calibration fail level 2 for 2^{nd} DO sensor (signal too low)
0223	“HD2 XS NOISE”	- Calibration fail level 3 for 2^{nd} DO sensor (signal too noisy)
0224	“HD2 XS SLOPE”	- Calibration fail level 4 for 2^{nd} DO sensor (signal not stable)
0225	“HD2 XS ADJUST”	- Calibration fail level 5 for 2^{nd} DO sensor (autofactor too big/small)
0241	“HD1 MANUAL CAL”	- Manual calibration request for 1^{st} DO sensor
0242	“HD2 MANUAL CAL”	- Manual calibration request for 2^{nd} DO sensor
0245	“COMMS MAN. CAL”	- Manual calibration request via communications port

…. More >>>

0251	"HEAD 1 CLEAN"	- Clean request for 1st DO sensor
0252	"HEAD 2 CLEAN"	- Clean request for 2nd DO sensor
0261	"HEAD 1 NEW"	- New cell request for 1st DO sensor
0262	"HEAD 2 NEW"	- New cell request for 2nd DO sensor
0271	"HD1 ZDO SET"	- Zero reset for 1st DO sensor
0272	"HD2 ZDO SET"`	- Zero reset for 2nd DO sensor)
0281	"HD1 USER CLEAR"	- User clear of previous request for 1st DO sensor
0282	"HD2 USER CLEAR"	- User clear of previous request for 2nd DO sensor
0291	"HD1 STATS OVRD"	- Statistics override of level 1 fail(s) for 1st DO sensor
0292	"HD" STATS OVRD"	- Statistics override of level 1 fail(s) for 2nd DO sensor

The following events are only shown if *restricted* event messaging is off (communication command REM=0) The default is event messages are restricted – REM=1, so these messages 8010 – 9021 are not recorded by default.

8010	"RELAY 0 OFF"
8011	"RELAY 0 ON"
8020	"RELAY 1 OFF"
8021	"RELAY 1 ON"
8030	"RELAY 2 OFF"
8031	"RELAY 2 ON"
8040	"RELAY 3 OFF"
8041	"RELAY 3 ON"
8050	"HD1 AERATE OFF
8051	"HD1 AERATE ON"
8060	"HD1 DOWN OFF"
8061	"HD1 DOWN ON"
8070	"HD1 UP OFF"
8071	"HD1 UP ON"
8080	"COMPRESSOR_OFF"
8081	"COMPRESSOR_ON"
8090	"DIG OUT09 OFF"
8091	"DIG OUT09 ON"
8100	"DIG OUT10 OFF"
8101	"DIG OUT10 ON"
8110	"DIG OUT11 OFF"
8111	"DIG OUT11 ON"
8120	"DIG OUT12 OFF"
8120	"DIG OUT12 ON"
8130	"HD2 AERATE OFF"
8131	"HD2 AERATE ON"
8140	"HD2 DOWN OFF"
8141	"HD2 DOWN ON"
8150	"HD2 UP OFF"
8151	"HD2 UP ON"

…. More >>>

8160	"DIG OUT 16 OFF"
8161	"DIG OUT16 ON"
9010	"DIG IN1 OFF"
9011	"DIG IN1 ON"
9020	"DIG IN2 OFF"
9021	"DIG IN2 ON"

See Also: [n/a]

‘FMA’ Command

Command: **FMA** – **F**ifteen **M**inute **A**verages

Purpose: This command allows the user to examine the last calculated fifteen-minute average data as scaled values in engineering units.

Keypad equivalent access: No keyboard equivalent – a serial communications command feature only.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read:	FMA {Param1}{Param2} **Where –** Param1 = 1st Pinfo entry to be examined Param2 = Last Pinfo entry to be examined
Write:	Not applicable

Remarks: None

Example:

Read:	`?FMA 1 5` `1.50 10.02 15.35 10.85 14.72`

In the example we are examining the first 5 fifteen-minute scaled averages

See also: FMR; OMA; OMA; RAW; SCL

‘IPN’ Command

Command : IPN – Alter the instrument’s **I**nstrument **P**ass**N**umber.

Purpose: To retrieve or set the passnumber which allows access to instrument specific settings via the front panel. The default is ‘3333’.

Local Keyboard menu accessibility:

You cannot change or examine passnumbers except via serial communications commands.

Applies to: All instruments	**User knowledge:** Advanced
Type: Both Read and Write	History: Issued October 1996

Syntax:

Read:	IPN
Write:	IPN= {new passnumber}

Remarks: A number between 1000 and 9999 should be used, although smaller numbers can be used with leading zeros so there are 4 digits. The default for this passnumber is ‘3333’. If the passnumber is forgotten, connecting to the instrument via serial communications and issuing the read command ‘IPN’ can retrieve it.

Example:

Read:	`?IPN` `3333`
Write:	`?APN=5678`

The read example shows the instrument reporting its current passnumber, which has not been changed from the default.

The write example shows the instrument specific passnumber being changed to ‘5678’.

See Also: APN; PSN; PPN

‘LCT’ Command

Command : LCT – 15-minute averaged data **L**ogging **C**a**T**alogue entries

Purpose: A command for specialist users. The probe maintains a catalogue of all the 15-minute average data areas it has logged. This command shows the catalogue information for each of these areas contained in the instrument.

Keyboard equivalent Access: None

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read :	LCT [param1] [param2] Where: param1 – 1st catalogue entry to be listed param2 – last catalogue entry to be listed
Write :	Not Applicable

Remarks: Each catalogue entry contains 5 data elements:

a. The number of points logged in the area. (24 – not alterable)
b. The number of minutes between each logging (15 - not alterable).
c. The inputs that have been logged. This number is a bit mapping of the inputs, displayed as a decimal number, with bit 0 representing input 1.
d. The number of integers that the logged area occupies.
e. The time stamp of when the detail area was started.

Example:

```
LCT  1  2
24 15 16 192 329    (18 Feb, 06:00)
24 15 16 192 329    (18 Feb, 12:00)
 a  b  c  d   e
```

In this example the logging catalogue entries 1 and 2 are examined. From this data it can be deduced that each entry represents 6 hours of data – i.e. 24 points, each point 15 minutes apart.

See Also: **DCT; DTS; LTS; OCT**

SEVERN TRENT SERVICES

'LOC' Command

Command : LOC – instrument **LOC**ation

Purpose: An instruction for basic users upwards. Lets you read or change the location reported by the instrument in response to the 'LOC' command and as used and reported by the 'FT' program and variants and displayed on 'GFX' graphs. Is also reported as part of the reply to the '**PIN'** and '**XPIN**' commands.

Keypad equivalent access:
No equivalent. Serial communications only feature.

Applies to: All instruments	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	LOC
Write:	LOC= {Location} Location is a string of up to32 alphanumeric characters

Remarks:

The default varies with the instrument and is typically some sort of description of the instrument – e.g. "Multi-Headed DO Probe System" or in older instruments "Minworth Systems Ltd."

When writing a new location to an instrument with the Terminal program, remember to temporarily turn off 'Force Upper Case' if you want to include lower case characters in the location text.

Example:

Read:	`?LOC` `Minworth Systems Ltd.`
Write:	`LOC=Unit 2, Lane 7, Middle`

The read example is reporting that the instrument Location is "Minworth Systems Ltd."

The write example is setting the instrument so the location will be reported as "Unit 2, Lane 7, Middle"

See Also: SIT; PIN; XPIN

'LTS' Command

Command : LTS – **L**ogging **T**ime**S**tamps for daily data (15 minute average)

Purpose: A command for specialist users. Returns a list of the Logged data time stamps

Keypad equivalent access: None

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	LTS {Stamp1}[Stamp2] Where – Stamp1 = Mandatory stamp or first in range of stamps Stamp2 = Optional end of range of stamps
Write:	Not applicable

Remarks: These time stamps are shorter than normal time stamps as they only contain Month, Date and Hour data, other than that they are encoded in exactly the same way. Stamp of 0 means no logged data. This is a subject of the information returned by the LCT command that is returned all on 1 line and is primarily used by Data File Transfer software (FT)

Example:

Read:	`?LTS 5 10` `156 157 158 159 160 161`

This example shows the user enquiring about the values of stamps 5 to 10.

See Also: LCT; DTS; DCT; OCT

SEVERN TRENT SERVICES

'NEW' Command

Command : NEW – <u>NEW</u> DO cartridge?

Purpose: Used to indicate to the software that a new DO cartridge has been fitted.

Local Keyboard menu accessibility:
Accessible via quit procedure from the '9999' – Maintenance menu.

Applies to:	All instruments with DO	User knowledge:	Advanced
Type:	Both Read and Write	History:	Issued October 1996

Syntax:

Read:	New
Write:	NEW= {flag} [Head number if multiheaded] Where: flag = 0 or 1

Remarks: In a multiheaded product the head number must be specified as well as the flag value. If the flag is 1 at the start of calibration, the calibration is performad as if for a brand new DO sensor. When the instrument is told it has a new DO sensor the calibration is different to a used sensor as follows….

The Corrected DO value is *always* derived from the raw DO by the formula

Corrected = Raw x Calibration Factor

During every normal calibration the calibration factor is calculated anew as…

Calibration factor = 100 / Raw

… so that after a successful calibration the corrected DO becomes 100 by virtue of the correction factor. This is different to a 'NEW' calibration, when the factor is initialised uncategorically to 1.000 exactly.

Example:

Read :	`NEW` `(65.39)0`
Write :	`NEW=1 2`

The read example says that the next calibration (of an instrument with a single DO sensor) will be normal. The value in brackets is for AZTEC in-house diagnostics and should be ignored. The write example tells the software that head 2 of a multiheaded DO instrument has had a new cartridge fitted so it can take appropriate actions when it calibrates it.

See Also: User manual '9999' Menu

‘OCT’ Command

Command : OCT – <u>O</u>ne-minute Average <u>C</u>a<u>T</u>alogue entries

Purpose: A command for specialist users. The instrument maintains a catalogue of all the one minute average areas it has logged. This command shows the catalogue information for each of the areas contained in the instrument.

Keyboard equivalent Access: None

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read :	OCT [param1] [param2] Where: param1 – 1st catalogue entry to be listed param2 – last catalogue entry to be listed
Write :	Not Applicable

Remarks: Each catalogue entry contains 5 data elements:

a) Number of one minute averages per chunk
b) ‘1’ (to be used for future expansion)
c) Number of inputs to be logged.
d) Size of the one minutes average log entry in 12 bit elements
e) The time stamp of when the logged area was started

Later instruments give the parsed date/time as well as the timestamp

Example:

Read:

```
?OCT 1 3
30 1 8 120 118819 (18 Feb, 11:49)
30 1 8  36 118789 (18 Feb, 12:19)
30 1 8 120 118759 (18 Feb, 11:19)
a  b c  d     e      (f)
```

It can be seen from this example that catalogue entry 2 is currently filling with data and 36 of the 120 values have so far been inserted.

See Also: DCT; LCT; OMA

'OMA' Command

Command: OMA –<u>**O**</u>ne-<u>**M**</u>inute <u>**A**</u>verage

Purpose: A command for specialist users. It allows the user to examine the current one minute average data for any particular input in scaled engineering units.

Keyboard equivalent Access: None

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read :	OMA {param1}{param2} Where – Param1=1st Pinfo entry to be examined Param2=Last Pinfo entry to be examined
Write :	Not Applicable

Remarks: The values returned by this command are given as scaled data values. (Compare 'OMR' (not documented here) which has an analagous form but returns RAW ADC values (0 - 1023)

Example:

Read:	*?OMA 1 7* 32.7 19.4 21.5 100.2 59.6 22.3 21.9

In this example we are examining the One Minute Averages of the first 7 parameters in the pinfo

See Also: DCT; LCT; OMA

SEVERN TRENT SERVICES

'PIN' and 'XPIN' Commands

Command: **PIN** – Lists out the **PIN**fo or e**X**tended **PIN**fo

Purpose: A command for specialist users. Lets you see all the signals present in the instrument – their names, units and scale range.

Keypad equivalent access:

No equivalent facility – serial communications only command.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	PIN or XPIN
Write:	Not applicable

Remarks:

The difference between 'PIN' and 'XPIN' is that 'PIN' returns the PINFO information and 'XPIN' the EXTENDED PINFO.

- The first line is a number – how many signals are in the PINFO or XPINFO
- The second line is the site name (same as returned or set by '**SIT**' command)
- The third line is the location (same as returned or set by '**LOC**' command)
- Subsequent lines list each parameter, its engineering units and the scale range (lsd and fsd).

All signals that are reported by PIN are also reported by XPIN, but the reverse is not true. Furthermore, the number of a particular signal within the PIN list is not necessarily the same in the XPIN list. The example below, for a multiheaded DO system illustrates these issues. Note in the example the PIN reports 16 signals, whereas the XPIN reports 32. Signals which only appear in the XPIN need to be accessed via the corresponding EXTENDED command to change them – e.g. '**XTXT**'; '**XPUN**'; '**XPSF**' rather than '**TXT**', '**PUN**' or '**PSF**'.

More>>>

Examples:

<table>
<tr><td>Read:</td><td>?PIN or XPIN

?PIN
<pre>
16
Minworth Systems Limited
Multi-Headed DO probe System
d.o 1 input(D)   Vdc   0.00000 5.00000
temperature 1   deg C   0.00000 50.0000
autocal d.o 1   %sat   0.00000 130.000
a.cal held d.o 1   %sat   0.00000 130.000
absolute d.o 1   mg/l   0.00000 10.0000
abs held d.o 1   mg/l   0.00000 10.0000
d.o 1 at calib   %sat   0.00000 130.000
g_cal 1 a.fact   variable 0.00000 4.00000
d.o 2 input(D)   Vdc   0.00000 5.00000
temperature 2   deg C   0.00000 50.0000
autocal d.o 2   %sat   0.00000 130.000
a.cal held d.o 2   %sat   0.00000 130.000
absolute d.o 2   mg/l   0.00000 10.0000
abs held d.o 2   mg/l   0.00000 10.0000
d.o 2 at calib   %sat   0.00000 130.000
g_cal 2 a.fact   variable 0.00000 4.00000
</pre></td></tr>
</table>

The above example is for a PIN – compare this with the corresponding 'XPIN' partially listed below…

<table>
<tr><td>Read:</td><td>
<pre>
?XPIN
26
Minworth Systems Limited
Multi-Headed DO Probe System
d.o 1 input(D)   Vdc   0.00000   5.00000
raw temp 1   deg C   -10.00000   63.7000
raw sat d.o 1   %sat   0.00000   130.000
temperature 1   deg C   0.00000   50.0000
autocal d.o 1   %sat   0.00000   130.000
etc …
      … (another 21 paramaters)
</pre></td></tr>
<tr><td>Write:</td><td>Not applicable</td></tr>
</table>

See Also: XTXT; XPUN; XPSF; TXT; PUN; PSF; DSP; XDSP; XLOG

SEVERN TRENT SERVICES

‘PIP’ and ‘XPIP’ Commands

Command: **PIP, XPIP** – Lists out a subset of the **P**info **I**n**P**uts or e**X**tended **P**info **I**n**P**uts

Purpose: A command for specialist users. Lets you see a chosen range of the signals present in the instrument – their names, units and scale range. Like ‘**PIN**’ but works on a specified subset of the signals instead of all signals.

Keypad equivalent access:

No equivalent facility – serial communications only command.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	PIP {first}[last] or XPIP {first} [last] Where ‘first’ is the number in the pinfo or extended pinfo to show ‘last’ is the number in the pinfo or extended pinfo to show ‘first’ is mandatory; ‘last’ is optional
Write:	Not applicable

Remarks:

The difference between ‘**PIP**’ and ‘**XPIP**’ is that ‘**PIP**’ returns data from the PINFO information and ‘**XPIP**’ from the EXTENDED PINFO information. Each line reported lists each parameter’s name, its engineering units and the scale range (lsd and fsd).

The number of a particular signal within the PIN list is not necessarily the same in the XPIN list so ‘**PIP**’ and ‘**XPIP**’ may produce slightly different results. Signals which only appear in the XPIN list need to be accessed via the corresponding EXTENDED command to change them – e.g. ‘**XTXT**’; ‘**XPUN**’; ‘**XPSF**’ rather than ‘**TXT**’, ‘**PUN**’ or ‘**PSF**’.

More>>>

Examples:

<table>
<tr><td>Read:</td><td><pre>
?PIP 1 8
 d.o input(D)   Vdc   0.00000 7.00000
 absolute d.o.   mg/l   0.00000 10.0000
 temperature   deg C   0.00000 50.0000
 area under curve mg/l   0.00000 100.000
 total area   mg/l   0.00000 200.000
 time to endog   Hours   0.00000 12.0000
 mlss corrected   mg/l   0.00000 10000.0
 resp rate/mlss   mg/g/h   0.00000 100.000

?XPIP 1 8
 d.o input(D)   Vdc   0.00000 7.00000
 autocal d.o.   %sat   0.00000 130.000
 absolute d.o.   mg/l   0.00000 10.0000
 temperature   deg C   0.00000 50.0000
 area under curve mg/l   0.00000 100.000
 total area   mg/l   0.00000 200.000
 time to endog   Hours   0.00000 12.0000
 mlss corrected   mg/l   0.00000 10000.0

?PIP 2
 absolute d.o.   mg/l   0.00000 10.0000

?XIP 2
 autocal d.o.   %sat   0.00000 130.000
</pre></td></tr>
<tr><td>Write:</td><td>Not applicable</td></tr>
</table>

These examples were taken from a BALL respirometer. The first two read examples show the effect of asking for the first 8 inputs in the pinfo and extended pinfo. The next two show the potential difference between a pinfo and an extended pinfo input with the same apparent number.

See Also: PIN, XPIN; TXT, XTXT; PUN, XPUN; PSF, XPSF; DSP, XDSP, XLOG

'PMD' Command

Command : PMD – **P**iston **M**ovement **D**elay or 'Probe movement delay'

Purpose: A command for specialist users. This instruction sets or reads the amount of time to allow the main pneumatic piston to move in response to a down or up request from the software. It can be useful in situations with abnormally long lengths of pneumatic tubing.

Keypad equivalent access:
No keyboard equivalent – serial communications command feature only.

Applies to:	Respirometers and DO	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	PMD
Write:	PMD= {time in seconds}

Remarks:

This function was introduced to cater for long lengths of pneumatic tube and types of valves that may be installation specific. The default value of 5 seconds is normally fine. However, if there is a lot of tubing it may need increasing because of the increased time taken in building up the pressure in the line before the piston or valve will have sufficient to operate cleanly.

Example:

Read:	`?PMD` `5`
Write:	`PMD=10`

The read example is reporting the current setting is 5 seconds.

The write example extends this to 10 seconds

See also: DWN, UPP for DO instruments

‘PPN’ Command

Command: PPN – Alter the instrument’s **P**info (General Menu) **P**ass**N**umber.

Purpose: A command for specialist users to retrieve or set the passnumber which allows access to the pinfo/setup menu via the front panel. The default is ‘1984’.

Local Keyboard menu accessibility:

You cannot change passnumbers except via serial communications commands.

Applies to: All instruments	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	PPN
Write:	PPN= {new passnumber}

Remarks: A number between 1000 and 9999 should be used, although smaller numbers can be used with leading zeros so there are 4 digits. The default for this passnumber is ‘8888’. If the passnumber is forgotten, connecting to the instrument via serial ommunications and issuing the read command ‘PPN’ can retrieve it.

Example:

Read:	?PPN 1984
Write:	?PPN=6789

The read example shows the instrument reporting its current passnumber, which has not been changed from the default.

The write example shows the passnumber being changed to ‘6789’.

See Also: APN; IPN; PSN

SEVERN TRENT SERVICES

‘PSF’ & ‘XPSF’ Commands

Command: **PSF & XPSF -** **P**info **S**caling **F**actor **and** e**X**tended **P**info **S**caling **F**actor

Purpose: A command for specialist users to examine a group of inputs’ scaling factors or to change individual scaling factors.

Keypad equivalent access: Accessible via ‘1984.1’ – PINFO submenu

Applies to: All instruments	**User knowledge:** Advanced
Type: Read and Write	**History:** Issued October 1996

Syntax:

Read:	PSF= {First Element to display} [Last element to display] XPSF= {First Element to display} [Last element to display]
Write:	PSF={Signal position in pinfo} {scale low (lsd)} {Scale high)fsd)} XPSF={Signal position in extended pinfo} {scale low (lsd)} {Scale high)fsd)}

Remarks: The ‘**XPSF**’ command behaves like the ‘**PSF**’ command but it refers to positions in the extended pinfo rather than the (normal) pinfo. All PSFs receive initial default values at cold startup. You should not set scale low and scale high to the same value. If you do, the signal value will always be reported as zero.

WARNING: ADJUSTING THE SCALE RANGE OF A SIGNAL ALSO AUTOMATICALLY PROPORTIONALLY RESCALES THE VALUES USED BY ANY ANALOGUE OUTPUT ASSIGNED TO THAT SIGNAL.

[Refer to the instrument manual and the ‘AOP’ command]

(Note: Expert/Specialist Information - It also affects alarm values, but only in those commands working on RAW units like the ALM command, and not those working in EU (user units) like the SAL command)

Examples:

Read:	`?PSF 1 3`
	`0.0 500`
	`-10  50`
	`  0 130`

Write:	`XPSF=5 40.0 100.0`

The read example reports the low and high scale range of the first three signals in the order reported in the normal pinfo. The write example changes the scale range of the fifth signal as reported in the extended pinfo to have a scale range of 40 to 100 engineering units. If an analogue output were assigned to this input, it would automatically be changed so that 40 units would produce 4.0 mA and 100 units would produce 20.0 mA. To change a number of signals’ scaling factors you must change each one individually by a separate ‘PSF’ or ‘XPSF’ write command.

See Also: PIP, XPIP; PIN, XPIN, SAL, XSAL; TXT, XTXT; VAL,XVAL;

'PSN' Command

Command: PSN – Alter the instrument's Manual operation **P**a**S**s**N**umber.

Purpose: To retrieve or set the passnumber which allows access to the maintenance/ manual operation menu via the front panel. The default is '9999'.

Local Keyboard menu accessibility:

You cannot change passnumbers except via serial communications commands.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History**:	Issued October 1996

Syntax:

Read:	PSN
Write:	PSN= {new passnumber}

Remarks: A number between 1000 and 9999 should be used, although smaller numbers can be used with enough leading zeros so there are 4 digits. The default for this passnumber is '9999'. If the passnumber is forgotten, connecting to the instrument via serial communications and issuing the read command 'PSN' can retrieve it.

Example:

Read:	`?PSN` `9999`
Write:	`?PSN=5890`

The read example shows the instrument reporting its current passnumber, which has not been changed from the default.

The write example shows the passnumber being changed to '5890'.

See Also: **APN; IPN; PPN**

‘PUN’ and ‘XPUN’ commands

Command: PUN and XPUN - Pinfo UNits and eXtended Pinfo Units

Purpose: A command for specialist users to examine a group of inputs’ engineering units or to change individual engineering units.

Keypad equivalent access: No keyboard equivalent – Serial communications feature only

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read and Write	**History:**	Issued October 1996

Syntax:

Read:	PUN {First Element to display} [Last element to display] XPUN {First Element to display} [Last element to display]
Write:	PUN={Signal position in pinfo} {Text of up to 8 characters} XPUN={Signal position in extended pinfo} {Text of up to 8 characters}

Remarks: The ‘**XPUN**’ command behaves like the ‘**PUN**’ command but it refers to positions in the extended pinfo rather than the (normal) pinfo. All PUNs/XPUNs receive initial default values at cold startup. If you enter more than 8 characters for {Text} only the first 8 characters will be used.

Examples:

Read:	`?PUN 1` `Volts DC`
Write:	`XPUN=2 degrees`

The read example reports the engineering units of the first signal in the pinfo is Volts DC.

The write example changes the engineering units of the second signal in the extended pinfo to degrees.

Note: If using the Terminal PC program you will need to temporarily uncheck ‘force upper case’ in the under the options menu in order to use lower case characters in the engineering units in a PUN write command.

See Also: PIP, XPIP; PIN, XPIN; PSF, XPSF

'QST' Command

Command : QST – DO sensor **Q**uick calibration **ST**atistics

Purpose: A command for specialist users. Permits examination of the calibration statistics for a DO sensor performing quick calibrations.

Keypad equivalent access: A serial communications function only

Applies to: All instruments with DO, including respirometers.	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	QST {start} {end} or QST {start}{end}{head} Where: Start is the number of the first or only set of statistics to view End is the number of the first or only set of statistics to view Numbers for the statistics start at one and can go to a maximum of 16 Head is the head number for multiheaded DO instruments.
Write:	Not applicable – read only

Remarks: During the DO sensor autocalibration, at a time when the reading is expected to have levelled off, two consecutive regions, each lasting 1 minute for long calibrations, are analysed. Statistical analyses of these two regions are made using criteria set by 'CAQ' to see whether the calibration should be accepted or not. The 'QST' command allows the user to examine the results of these statistical tests.

Example:

Read:	?QST 1 5 1.045 457078 95.56 0.115 95.67 0.108 95.61 95.67 1.045 0 1.041 456749 95.92 0.104 96.06 0.101 95.99 96.06 1.045 0 1.046 456518 95.47 0.114 95.60 0.107 95.54 95.60 1.045 0 1.034 456237 95.59 0.198 96.66 0.101 95.63 96.66 1.045 0 1.039 455751 96.15 0.099 96.27 0.091 96.27 96.27 1.045 0
Write:	Not applicable

The read example needs further explanation. If we label the fields to assist in describing them, for example for the latest statistics, reported on the first line…

```
1.045 457078 95.56 0.115 95.67 0.108 95.61 95.67 1.045 0
 'a'    'b'     'c'    'd'    'e'    'f'    'g'     'h'   'i'  'j'
```

Then the meanings of the fields are as follows:

a. The calibration factor. Originally set to exactly 1.000 when the instrument is told the sensor is new. '1.045' means a 4.5% correction compared with the last accepted long calibration is currently in force.
b. The (coded) date time stamp when the calibration cycle began, to 1-minute resolution
c. The average of the first data area - i.e. the first of the two three-minute areas at that part of the calibration where the response would be expected to be levelling off.
d. The standard deviation of the first data area – indicator of the amount of noise
e. The average of the second data area i.e. the second of the two three-minute areas at that part of the calibration where the response would be expected to be levelling off.
f. The standard deviation of the first data area – indicator of the amount of noise
g. The mean of the two separate means
h. The mean actually used at calibration
i. The autocalibration correction factor now in use. The signal is being multiplied by 1.045 of what it was when the instrument was told the sensor was new
j. The calibration 'level of fail', zero to five, where:

    0. Did not fail – The calibration passed all the checks
    1. Failed because the percentage difference from the last successful calibration was too great.
    2. Failed because the cell output was too low – less than 20% of what it was when new.
    3. Failed because one or other standard deviations was too large. In other words the signal was too noisy.
    4. Failed because the difference between the 2 sample means was too big. In other words, the DO was still rising with time – a sufficiently stable straight line had not established.
    5. Failed because the auto adjustment factor was too big or too small – i.e. outside what was acceptable according to the percentage change setting.

In the example, no calibrations were rejected.

Note when a calibration is rejected, the first field ('a') is set to zero (0).

See Also: CAQ; CSC; CTS; CTY; QST; QTS for all DO instruments + respirometers
and CBH; CIA; CYC for DO instruments only

'QTS' Command

Command : **QTS** – DO sensor **Q**uick calibration **T**ime**S**tamps

Purpose: A command for specialist users. Returns the calibration factors, along with the timestamps when the calibration that occurred was a quick calibration (or the early section of a long calibration).

Keypad equivalent access: None

Applies to: All DO instruments + respirometers.	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	QTS {first} {last} {head, if multi-headed}
Write:	Not applicable

Remarks: The returned data follows the pattern of a floating point number - the calibration factor - and a following integer, representing the time stamp of the calibration. This will be repeated for all the data asked for. As new calibrations are carried out, the new data is inserted at the top of the list and the oldest discarded. The calibration time stamps will be listed in the order, most recent at the start of the list and oldest at the end of the list.

Example:

Read:	`?QTS 1 5`
	`1.003   12345`
	`1.00676 15432`
	`1.01    16543`
	`1.0     16577`
	`0.0     0`

In this example time stamps 1 to 5 have been requested. Only 4 calibrations have been made though as indicated by the last reported element having no time stamp. Note that the first calibration factor is exactly 1.0 This will always be the case where the probe has been told it has a new cartridge.

Each line ends with the parsed (actual) data and time of the quick calibration and starts with the head number if the instrument is multiheaded.

Note that a long calibration also calculates quick calibration information from its early stages. Examination of this information in comparison with the corresponding full (Long) calibration information can help to make an informed decision as to whether quick calibrations are feasible.

See Also: CAL, CBH, CSC, CST, CTS, CTY, CYC, QST

'RAW' Command

Command: **RAW** – Display **RAW** (unscaled, ADC units) Input data

Purpose: A command for specialist users. This command reads the raw values of the inputs. The numbers returned from this command are expressed as decimal integers in the range 0 to 4095.

Keypad equivalent access:

Serial communications function only

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	RAW {Param1}[Param2] Where: Param1 = Mandatory Pinfo input channel number Param2 = Optional end of range channel number
Write:	Not applicable – read only

Remarks: This command lets the user view the raw analogue to digital conversion for the required pinfo input(s). At the present time the analogue to digital converter used has a 12-bit resolution, thus the range of values in this command is 0 to 4095, with 4095 being the full scale reading.

Example:

Read:	`?RAW 1 3` `244 3705 4095`
Write:	`Not applicable`

In the example the inputs 1 to 3 are requested. The reply lists all inputs as integers on a single line. Input 3 is reading full scale.

See Also: **FMA, FMR, OMA, OMR, SCL**

'RDT' Command

Command: RDT – Read DeTail area

Purpose: A command for specialist users. This command allows access to all of the detail area catalogues data.

Keypad equivalent access:
Serial communications function only

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	RDT {Catalogue} {Offset} [Count] Where:- Catalogue = Detail catalogue that data is required from. Offset = Offset (in integers) into the catalogue Count = Number of integers to read from the catalogue.
Write:	Not applicable – read only

Remarks: The reply consists of a list of integers. Each integer is 24 bits, printed as a signed decimal. The high 12 bits are the first analogue value, the low 12 bits are the second. If more than a certain number of integers are requested (10 in current releases) the instrument sends them on multiple lines, with 10 on each line. It is possible to read the whole of a detail area in one go, by requesting all the integers. The size of the catalogue entry can be determined by means of the DCT command.

Example:

Read:	i) ?***RDT 1 1*** 2429533 214736 2335302 235215 2560638 333518 ….. … 3642252 415438 44543596 489166 ii) ?***RDT 1 1 20*** 2429533 214736 2335302 235215 2560638 333518 … … 3642252 415438 4543596 489166 5354806 562894 6166016 587470 6436419 607950 … … 6661755 657103 7194369 730831
Write:	Not applicable

See Also: **FMA, FMR, OMA, OMR, SCL**

'RLG' Command

Command: **RLG** – **R**ead 15-minute averaged **L**o**G**ged data

Purpose: A command for specialist users. Allows the retrieval of logged data values from an instrument. Values returned are displayed as 24 bit integers. Two values are packed in each integer the high 12 bits are the first analogue value, the low 12 bits the second.

Keypad equivalent access: Serial communications function only

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	RLG{Chunk}{Offset}[Num] Chunk = Log Catalogue Number, also called chunk data Offset = Offset into the chunk of data (Start=0) Num = Number of items to retrieve (default is 10)
Write:	Not applicable – read only

Remarks: When a new entry is made in a chunk it firstly initialises the whole chunk. This process involves writing FFFFFF hex into each variable element. As the numbers are stored as signed 24 bit values, when they are printed out the value returned will be – 1 decimal. As data is logged these –1 values are overwritten. You can see how full a catalogue is by seeing how much of it holds the value –1. The other reason a catalogue may hold a –1 value is if the ADC of *both* logged inputs squashed into the single integer are at full scale. A good way of deciding how far the instrument has logged in the chunk is to read the time (TIM) and compare it to the time stamp in the catalogue.

Example:

Read: i)

```
?RLG  1  1
0 6906249  1610295  1610295  144566  0  6910352 …
                       … 1638976  1638976  148661
```

Example (i) reads from an offset of 1 into chunk 1 of logged data. The assumption only 10 items are to be retrieved has been made by the software as the third argument is missing.

ii)

```
?RLG  1  1  20
0 6906249  1610295  1610295  144566  0  6910352 …
                        …  1638976  1638976  148661
0 6906264  1671757  1671757  148661  0  6906270  …
                        …  1696342  1696342  152757
```

Example (ii) - as example (I) but this time the third argument has been used.

See Also: **LCT, LTS**

SEVERN TRENT SERVICES

‘ROM’ Command

Command : ROM - Read One Minute averaged logged data.

Purpose: A command for specialist users to retrieve logged one-minute averaged data values from an instrument.

Equivalent keypad command: None – serial communications command only

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Read only	**History:**	Issued October 1996

Syntax:

Read :	ROM {chunk}{offset}[length] Where: Chunk = One minute average Log Catalogue Number Offset = Offset into the chunk of data (start = 0) Length = Number of items to retrieve (default is 10)
Write :	Not applicable

Remarks: Values returned are displayed as 24-bit integers, two (raw ADC) readings being packed into each integer. The high 12 bits are the first analogue value, the low 12 bits the second.

Example:

Read :	i) ?***ROM 1 1*** 9096444 2840465 647433 456910 9112827 2889633 … … 647586 45696710 9080059 2922323 This example reads from an off set of 1 into chunk 1 of logged data. The assumption that only 10 items are to be retrieved has been made by the software as the third argument is missing. ii) ?***ROM 1 1 20*** 9096444 2840465 647433 456910 9112827 2889633 … …. 647586 4569610 9080059 2922323 647658 4569610 8928507 2934344 647446 4569612 … … 8862970 2938343 528505 4631052 As example (i) but this time the third argument has been used.

See Also: OCT; OMA *(also undocumented JBU)*

'RST' Command

Command : RST – **R**e**S**e**T** the instrument's processor module

Purpose: A command for specialist users. This command must be used in conjunction with the '**WRM**' command, which dictates whether the restart triggered by '**RST**' will be a warm or a cold restart. It should not be undertaken without fully appreciating the consequences!

> **WARNING:** A 'DANGEROUS' COMMAND – IF A COLD RESTART ENSUES, THEN ANY CHANGES WHATSOVER THAT HAVE BEEN MADE TO THE INSTRUMENT'S DEFAULT SETTINGS WILL BE LOST. IT WILL REVERT TO ITS FACTORY DEFAULT SETTINGS AND ANY LOGGED DATA WILL BE IRRETRIEVABLY ERASED!

Keypad equivalent access:

There is no keyboard equivalent – However the instrument can be **cold** restarted as follows**:**

On MADOS V, turn off the power; remove the battery backing link on the Proteus module; wait 30 seconds; replace the link; restore the power.

An instrument can be **warm** restarted by turning the mains (line) power off then back on.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Write only	**History:**	Issued October 1996

Syntax:

Read:	RST
Write:	RST= {passnumber}

Remarks:

The passnumber is the same as that used to enter manual mode from the keypad – usually '9999'. The value set by the 'WRM' command decides whether a cold or warm restart ensues. **Use this command with extreme caution. It should be regarded as an emergency mechanism for restarting an instrument remotely and strictly for expert use.**

Example:

Write:	`?RST=9999` `Processor reset`

See also: WRM

‘SAL’ and ‘XSAL’ Commands

Command: **SAL** – **S**etup **AL**arm Outputs using scaled values (i.e. engineering units)

Purpose: A command for specialist users. To set up conventional alarms using the available digital outputs using real engineering units values, unlike ALM and XALM, which use RAW input values. Most users are more likely to want to use real engineering values.

Local Keyboard menu accessibility:
You can set up digital outputs as conventional alarms, using engineering units to set the alarm limit, via the ‘8888.1’ digital outputs setup submenu – DIG_ALARS.

Applies to:	All instruments	**User knowledge:**	Advanced
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read :	SAL {start} {end} or XSAL {start} {end} ‘start' = number of the first alarm to view ‘end' = number of the last alarm to view
Write :	SAL={alarm} {input}{type}{setpoint}{enable} or XSAL={alarm} {input}{type}{setpoint}{enable} ‘alarm' = Number of the alarm output to set ‘input’ = which input to use as the signal source to check, as numbered in the pinfo or extended pinfo ‘type’= what type of alarm to set up as follows… 0 = lo.1 – i.e. low alarm set to 1 if breached 1 = hi.1 – i.e. high alarm set to 1 if breached 2 = lo.0 – i.e. low alarm reset to 0 if breached 3 = hi.0 – i.e. low alarm reset to 01 if breached 4 = rt.1 – Special – Rate of change alarm, raised if breached ‘set point’= the value, in real units LSD –FSD, which if breached will result in the alarm triggering. ‘enable’= a flag. If 0, the alarm is disabled – it will not trigger even if breached; if 1 it is enabled and will trigger if breached.

>>> more

Remarks:

If the input signal assigned to the alarm output reaches or goes beyond the alarm set point - i.e. is above a high alarm or below a low alarm – and the alarm is enabled, then the alarm digital output will go to a state dictated by the {type} set when the alarm was set up.

Setting the alarm setpoints with this command is accomplished using the engineering units range for the alarm input in question. This has been done for most users who are unlikely to want to work in RAW units using 'ALM'.

N.B. *Adjusting the Pinfo scaling factors (via 'PSF') of an input used in an alarm will alter the scaled value in the alarm (but not the ADC value). Therefore the 'SAL' value should always be checked after using 'PSF', to confirm it still reflects what was intended.*

Example:

Read :	`?SAL 1`
	`ALM 01 06 (abs held d.o 1) 01 (Hi.1) 3.0 1`
	
	This example shows that the scaled alarm output 1 is allowed to alarm. It will alarm when parameter 6 reaches the high setpoint value of 3.0 (engineering units).
	
	If the input number is omitted from the read command, then all available alarms will be reported.

Write :	***?SAL=1 2 1 80 1*** In this example, the user is setting parameter 2 alarm to output a '1' ('ON', 'high') on a high alarm of 80 engineering units, and the alarm is to be enabled. If the engineering units are out of range an error will be generated. To find ranges use 'PIN' or 'PIP' (or the 'XPIN' / 'XPIP') commands.

See Also: ALM; XALM; ALC; XGAL; XGRA

SEVERN TRENT SERVICES

'SCL' Command

Command: **SCL** – Display **SCaLed** Input data

Purpose: This command reads the scaled values of the inputs. The numbers returned from this command are expressed in the real engineering units of the requested parameter(s)

Keypad equivalent access:

A serial communications function only. Current values can be scrolled through on the LCD in normal operating mode via the 'YES' and 'NO' keypads

Applies to: All instruments	**User knowledge:** Basic
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	Read – SCL {Param1}[Param2] Where:- Param1 = Mandatory Pinfo input channel number Param2 = Optional end of range channel number
Write:	Not applicable – read only

Remarks: This command lets the user view the scaled values for the required pinfo input(s). A point to note is the rare but possible circumstance that inputs read with this command could read zero engineering units, but the *RAW* signals could actually be reading full scale out of range. This is because if the adc converter is swamped (off scale high), the kernel software returns a value of zero.

Example:

Read:	`?SCL 1 5`
	`30.2897 7.08412 11.4992 5.86325`
	`?`
	
	In this example the request is for the current readings, in their scaled engineering units, for parameters 1 to 5. The reply provides them as a list of floating point numbers, all on one line.

Write:	`Not applicable`

See Also: **FMA, FMR, RAW, OMA, OMR, VAL**

SEVERN TRENT SERVICES

'SET' Command

Command: **SET**– **<u>SET</u>** instrument date and time

Purpose: An instruction for basic users upwards. Lets you set the instrument date and time in one command. They can be set individually by the DAT and TIM commands, which is the more usual method.

Keypad equivalent access:
'1234' – clock setting menu or '1984.2' – General Setup – clock submenu.

Applies to: All instruments	**User knowledge:** Basic
Type: Write only	**History:** Issued October 1996

Syntax:

Write:	SET={hour}{mins}{date}{month}{year} Where:- Hour = Hours (24 hour format) Mins = Minutes Date = Date of month Month = Month number (January = 1) Year = Year (excluding century)

Remarks:
Due to a limitation of the Real Time Clock used in the instrument, it is not possible to set the seconds part of the time.

Example:

Write:	`Write –`
	`?SET=13 40 08 02 03`
	`?`
	
	This example sets the time to 1.40pm (13:40) and the date to the 18th February 2003

See Also: **DAT; TIM**

'SIT' Command

Command: **SIT**– name the instrument's **SIT**e

Purpose: An instruction for basic users upwards. Lets you read or change the site reported by the instrument in response to the 'SIT' command and as used and reported by the 'FT' and 'GFX' programs and variants. It is reported as part of the reply to the '**PIN'** and '**XPIN**' commands.

Keypad equivalent access:

No equivalent. Serial communications only feature.

Applies to: All instruments	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	SIT
Write:	SIT= {Site} Site is a string of up to32 alphanumeric characters

Remarks:

The default varies with the instrument and is typically some sort of description of the instrument – e.g. "AZTEC Series 5000 DO" or in older instruments "Minworth Systems Ltd.". If using the terminal program remember to temporarily turn off 'Force Upper Case' in the options if you want to use lower or mixed case letter in the site name.

Example:

Read:	`?SIT` `Minworth Systems Ltd.`
Write:	`SIT=STS R&D Laboratory`

The read example is reporting that the instrument site is "Minworth Systems Ltd."

The write example is setting the instrument so the site will be reported as "STS R&D Laboratory"

See Also: **LOC; PIN; XPIN**

'SLT' Command

Command : SLT – **S**a**L**ini**T**y of measured process liquor

Purpose: A command for specialist users. Allows Dissolved Oxygen readings to be compensated for the effect of salinity of the measurement medium on the solubility of oxygen.

Keypad equivalent access:

Accessible via the '1987' menu

Applies to: Mados V DO and later	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued Feb 2000 MADOS V only

Syntax:

Read:	SLT
Write:	SLT={salinity in mg/l as chloride ion} Accepted range 0 – 10000, default 0.

Remarks: This command has the same function as the SALINITY menu (Passnumber '1987'). It allows dissolved oxygen measurement to be corrected for the effect of dissolved salts in the measured medium. The error in not correcting varies with temperature and salinity. As an example, at 20 degrees C with a salinity of 10,000 mg/l (1.0% w/v) as chloride, or 1.6% w/v as sodium chloride, the error would be about a 10% overestimation of the dissolved oxygen concentration.

Example:

Read:	?***SLT*** 0
Write:	***SLT=10000***

In the read example, the salinity was found set to the default zero (pure water).

In the write example the salinity has been set to 10000 mg/l as chloride. (16000 mg/l as NaCl).

See Also: ALT; ATM; SLT; DEP

‘TIM’ Command

Command : TIM – Set the instrument’s current **TIM**e

Purpose: An instruction for all users. It lets you set the time of the battery-backed real-time clock in the instrument.

Keypad equivalent access:

‘1234’ – clock setting menu or ‘1984.2’ – General Setup – clock submenu.

Applies to:	All instruments	**User knowledge:**	Basic
Type:	Both Read and Write	**History:**	Issued October 1996

Syntax:

Read:	TIM
Write:	DAT= hh:mm:ss or TIM=hh:mm

Remarks: ‘hh’ represents hours; ‘mm’ minutes and ‘ss’ seconds. Each one has two digits.The time is entered and reported in 24hr clock format with colons ‘:’ as the separator. It is important that the date and time are set correctly if data logging is to work properly. The instrument will not perform correctly after a cold start until the date and time are set correctly.

Example:

Read:	`?TIM` `TIME 08:39:18`
Write:	`TIM=08:41:15`

The read example is reporting that the instrument time is set to set to 08:39:18.

The write example is setting the time to 08:41:15. The form TIM=08:41 would have set the seconds to zero – i.e. 08:41:00. The new time takes effect as soon as the instrument receives the command.

See Also: DAT; (SET)

‘TRG’ Command

Command : TRG – <u>Tri</u><u>G</u>ger a detailed logging area

Purpose: A command for specialist users. Allows you to trigger a detailed area or examine the status of the detailed area trigger flag.

Keypad equivalent access: None – serial communications feature only

Applies to: All instruments	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	TRG
Write:	TRG= 0 or 1

Remarks: Setting TRG to 1 requests a detailed logging area to be started, assuming one is not already in progress. Setting TRG to zero stops a current detail area if one is in progress

Example:

Read:	`?TRG` `0`
Write:	`TRG=1`

The read example is reporting that the instrument is currently not logging a detailed area.

The write example is setting the instrument to log a detailed area. The signals logged will be governed by the ‘**DTI**’ command and the duration of the detailed area and interval between readings by the ‘**DET**’ command.

See Also: DET; DTI; (DCT, DTS, RDT)

SEVERN TRENT SERVICES

'TXT' Command

Command: TXT, **XTXT** - Pinfo **T**E**XT** and e**X**tended Pinfo **T**e**XT**

Purpose: A command for specialist users to examine a group of inputs' textual description – i.e. their names - or to change individual descriptions

Keypad equivalent access: No equivalent – Serial communications feature only

Applies to: All instruments	**User knowledge:** Advanced
Type: Read and Write	**History:** Issued October 1996

Syntax:

Read:	TXT {First Element to display} [Last element to display] XTXT {First Element to display} [Last element to display]
Write:	PTXT={Signal position in pinfo} {Text of up to 16 characters} XTXT={Signal position in extended pinfo} {Text of up to 16 characters}

Remarks: The '**XTXT**' command behaves like the '**TXT**' command but it refers to positions in the extended pinfo rather than the (normal) pinfo.

All TXTs/XTXTs receive initial default values at cold start-up. If you enter more than 16 characters for {Text} only the first 16 characters will be accepted.

If using the Terminal program, turn off 'Force Upper Case' temporarily if you want to write a text description containing lower or mixed case characters.

Examples:

Read:	`?TXT 1`
	`d.o input(D)`
	
	`?TXT 2 3`
	`absolute d.o.`
	`temperature`

Write:	`XTXT=12 Raw Temperature`

The first read example reports the name of the first signal in the pinfo is "d.o. cell signal". The second example shows the names of the second and third signals.

The write example changes the name of the twelfth signal in the extended pinfo to "Raw Temperature".

See Also: PIP, XPIP; PIN, XPIN; PSF, XPSF, SIT; LOC

SEVERN TRENT SERVICES

'UPP' Command

Command : UP or UPP – raise probe **UP** into the ball or shroud from the **P**rocess

Purpose: Used to monitor and/or control the DO cartridge up request flag

Keypad equivalent access:
Can also be accomplished via the 9999.1 maintenance menu

Applies to: All instruments	**User knowledge:** Basic
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	1 head UPP	multihead UPP {head}
Write:	1 head UPP={0/1}	multihead UPP={0/1}{head}

Remarks: Remember the safety warnings about the possible danger of the power of pneumatically motivated probe movements.

Setting this flag does not guarantee that the assembly will actually go up into the ball or shroud. If the instrument operation has been suspended from the front panel, this flag is ignored. During an autocalibration this flag is ignored too. Assuming the flag is not being ignored, it remains set until the cartridge is fully up and is then cleared. If the flag is being ignored, then eventually it will be cleared by the probe anyway. In a multi-headed product the head must be specified.

Example:

Read:	?UPP 0
Write:	?UPP=1 2

The read example is reporting that the up flag is not set

The write example is setting the instrument so the up flag is set i.e. a request for the probe to move up is sent for head 2 of a multihead DO

See Also: AIR; DWN

‘VAL’ & ‘XVAL’ Commands

Command: VAL, XVAL - Pinfo signal’s **VAL**ue **and** e**X**tended pinfo signal’s **VAL**ue

Purpose: A command for specialist users to examine a group of inputs’ current values.

Keypad equivalent access:

The nearest keyboard equivalent is to scroll through examining the inputs on the LCD via the keypad ‘YES’ and ‘NO’ keys.

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	VAL {First Element to display} [Last element to display] XVAL {First Element to display} [Last element to display]
Write:	Not applicable

Remarks: The ‘**XVAL**’ command behaves like the ‘**XVAL**’ command but it refers to positions in the extended pinfo rather than the (normal) pinfo.

Examples:

Read:	`?VAL 1 3`
	`d.o input(D)     Vdc     3.07350`
	`absolute d.o.    mg/l    8.26347`
	`temperature      deg C   24.7517`

Write:	`Not applicable`

The first read example reports the current values of the first 5 signals in the pinfo. It lists the name, engineering units and current value of each requested signal in turn.

See Also: TXT, XTXT; PIP, XPIP; PIN, XPIN; PSF, XPSF

'VER' Command

Command: **VER** – **VER**sion of software in instrument

Purpose: Used to examine the instrument software version and card population

Keypad equivalent access: None

Applies to: All instruments	**User knowledge:** Advanced
Type: Read only	**History:** Issued October 1996

Syntax:

Read:	**VER** {Level of detail} Where Level of detail is 0,1,2,3 or 4
Write:	Not applicable

Remarks: "Level of detail" has the following meaning…

- 0 or 1 The software version number and release date is returned
- 2 The instrument type plus the software version number and release date is returned
- 3 The date and time the software was built, plus the instrument type plus the software version number and release date is returned.
- 4 The population of cards in the electronics rack, plust the display type, plus the date and time the software was built, plus the instrument type plus the software version number and release date is returned.

Example: **(Series 5000)**

Read:

```
?VER 4
Multi-Headed DO System
0.06#a 07/02/2000
I/O Slot    0:    type 7
I/O Slot    1:    type 0
I/O Slot    2:    type 0
I/O Slot    3:    type 0
I/O Slot    4:    type 0
I/O Slot    5:    type 0
I/O Slot    6:    type 0
I/O Slot    7:    type 0
I/O Slot    8:    type 0
I/O Slot    9:    type 0
I/O Slot    10:   type 0
I/O Slot    11:   type 0
I/O Slot    12:   type 0
I/O Slot    13:   type 0
LCD:  2 line(s)
?
```

Series 5000 cannot automatically scan for daughterboards. It always reports one board – the motherboard, and reports it as a 'Type 7'

See Also: CFG

'WRM' Command

Command: **WRM** – **W**ar**M** Start **S**tatus

Purpose: A command for specialist users. It lets you read or change the warm start flag. This flag controls whether the next restart that occurs will be a warm or cold restart. If used in conjunction with the '**RST**' command it can let the user trigger a cold or warm restart remotely, totally via serial communications.

> **WARNING:** THIS COMMAND IS POTENTIALLY 'DANGEROUS' – IF A COLD START ENSUES, ANY CHANGES WHATSOVER THAT HAVE BEEN MADE TO THE INSTRUMENT WILL BE LOST AND ANY LOGGED DATA WILL BE ERASED IRRETRIEVABLY!

Keypad equivalent access:

No approved direct keyboard equivalent – However the instrument can be cold restarted by turning off the mains (line) power; taking off the battery backing link; (situated above the battery to the right of the Proteus CPU module) waiting 30 seconds; replacing the battery backing link and finally reinstating the mains (line) power. The instrument can be warm restarted by turning the mains (line) power off then back on, providing the WRM flag has not been modified to trigger a cold restart at next power down/up.

Applies to: All instruments	**User knowledge:** Advanced
Type: Read and Write	**History:** Issued October 1996

Syntax:

Read:	WRM (returns 2 numbers)
Write:	WRM= {0/1} {PassNumber} Where Passnumber is a safety facility – a number that must be entered before the command will be acted on.

Remarks: If the two numbers returned in response to the 'WRM' read command are both the same, then the next power up will be a warm power up and all the system data will be retained. If the two numbers returned are different then the next power up will be a cold power up and all the system data will be lost and replaced with the default settings.

>>> MORE

The actual values of the two returned numbers are not meaningful - only whether they are the same or different.

If the 'WRM' command returns two different numbers, indicating that a cold start will be executed next restart, you can change this - Writing this command, with the first number set to 1, will cause the two returned numbers to become the same and thus no cold start will occur.

Because of the potential data loss, this command is passnumber protected. The second parameter is a password. This is the same as the passnumber used for the front panel access to the manual mode menu (current default '9999'). If this passnumber is entered incorrectly then the command will be ignored.

Example:

Read:	`?WRM` `8888 8889`

Write:	`WRM=0 9999`
	`then read…`
	`?WRM`
	`8888 8888`

The read example is reporting two different numbers, indicating the next restart will be a **COLD** restart.

The write example sets the instrument so the next restart will be a **WARM** restart.

See Also: RST

'ZDO' Command

Command: ZDO - Raw input value at Zero DO concentration

Purpose: A command for specialist users. It permits inspecting or modifiying the offset of the reading of the DO raw input channel at zero DO.

N.B. This command works in RAW input units – NOT in engineering units!

Local Keyboard menu accessibility:

Accessible via '3333.3.2' – Instrument specific setup, O_CAL, ZDO submenu.

Applies to:	All instruments with DO	**User knowledge:** Advanced
Type:	Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	ZDO
Write:	ZDO= {RAW input value}[Head number if multiheaded]

Remarks: It is unlikely the DO sensor input channel zero offset will need changing. If the instrument is being habitually used at low DO levels (< 0.3 mg/l) and the user is concerned about even small discrepancies at these levels it may become an issue. Even then, the preferred method of calibrating and correcting zero DO is the manual method that has been described in the main manual under the '3333.3.2' submenu.

The definition of ZDO is the value of the UNSCALED and UNCALIBRATED DO input – i.e. the value that would be read from the raw DO signal card's analogue digital converter (ADC) when the cartridge is in a zero DO environment. Zero DO produces a zero cell output so ZDO id defaulted to zero.

Example:

Read:	?ZDO 0
Write:	ZDO=5 2

The read example says that the current ZDO is 0 - the default – on a single headed DO unit. The write example sets it to 5 raw ADC units for the second head of a double DO unit.

See Also: '3333 – Instrument-specific setup' section

[Section spacer page]

10 DO & DO-MLSS ROUTINE MAINTENANCE

The ***AZTEC DO / DO-MLSS system*** will periodically require attention from maintenance personnel and has been designed to allow the user to easily and quickly diagnose when maintenance is required before the integrity of the data is impaired.

10.1 Health & Safety

Please ensure that all safety matters detailed in the installation sections are read and understood, before attempting to carry out maintenance work.

10.2 Test Equipment

See *Section 5 Installation*

10.3 Programmed Maintenance

In terms of the recommended maintenance procedure, the *user* should be encouraged to be the initiator of maintenance activities. Interpretation of measurement data, by the user, will readily indicate the need for attention by maintenance personnel. With this strategy, maintenance will be carried out when it is actually required rather than instigating procedures based on breakdown and consequent loss of data.

However, the **DO sensing cell**, the **non-return valve**, the **cleaning brush**, the bronze sintered **air filter** and the fibre compressor box **silencer** are all consumable items. These **should be renewed once every twelve months** even if they are still functioning apparently satisfactorily.

The **cleaning brush** is a sprung-fit in its groove. As with all operations involving the wet end assembly, when replacing the cleaning brush observe all safety precautions. Remember that the pneumatics system is powerful enough to sever a finger. Also remember that the material coating the wet assembly is potentially hazardous, possibly both chemically and biologically, and wear appropriate protective equipment and handle it accordingly.

The inbuilt compressor box, if used, has a **sintered bronze air filter** on the outside at the right hand side of the base, which should be disconnected from the compressor inlet and unscrewed from the bottom of the enclosure for replacement.

A porous plastic **silencer** is fitted adjacent to the air filter and should be unscrewed from the enclosure and replaced at the same interval as the air filter.

The **non-return valve** in the **blue** air line below the valve block, in either the main electronics unit or LCB or both, is also a consumable unit and should be replaced annually. When replacing it be sure to orientate it correctly to permit airflow away from the compressor and valve control block towards the wet end.

10.4 Maintenance of the DO Wet End Assembly

The only serviceable instrumentation items on the AZTEC DO assembly are the DO cell, cleaning brush and, if a Makareth cell, the DO cell membrane.

The DO cell, cleaning brush and/or DO membrane are replaced when the DO Probe Assembly is removed from normal operation.

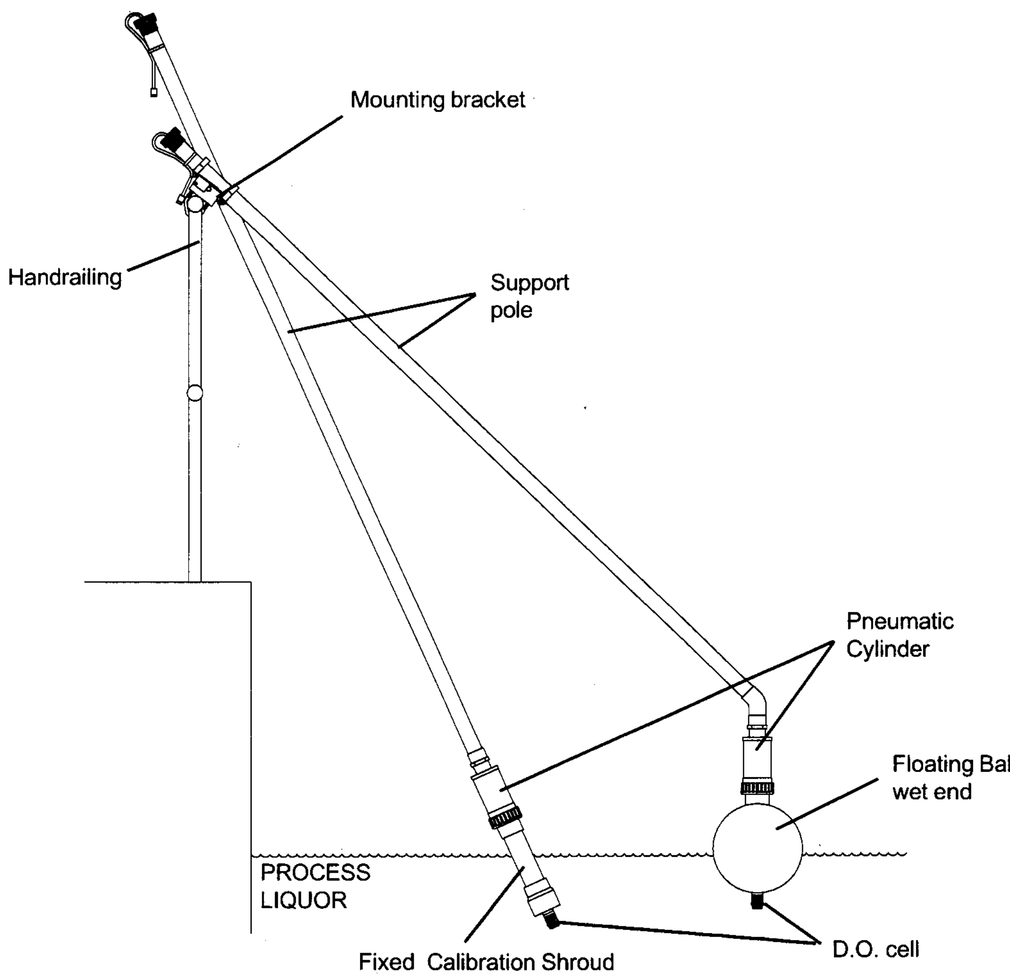


Figure 37 – Diagram of typical installations of floating ball and fixed shroud wet end assemblies

☞ Use the ‘1234’ MANUAL MENU to ensure that the probe is ‘UP’ before removing the pole.

The DO cell is located on the end of the wet end assembly pole. The cell will be either a ***Makareth*** or a ***Clark*** type. The electrode membrane on both cells is delicate and will be damaged by careless handling.

The ball/calibration shroud is removed by unscrewing its retaining nut in an anticlockwise direction until it becomes free and then sliding the shroud from the DO Probe Assembly. The sensor assembly is now exposed.

A damaged membrane (Makareth Cell) or cell assembly (Makareth and Clark cells) may be replaced as described on the following pages.

10.4.1 Fitting a new Makareth cell

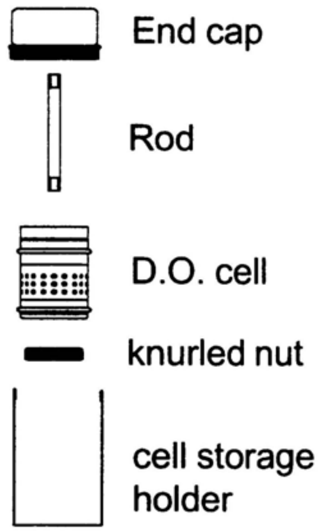
The Makareth DO cell is supplied in a cell storage holder that contains a solution of sodium sulphite. This ensures that the membrane remains wet and in good condition. The membrane is delicate and will be damaged by careless use. Inspect the electrode for signs of membrane damage and replace if necessary (see later).

WARNING

The Makareth cell is like a battery, slowly running down as it measures oxygen. It is supplied stored in an oxygen-absorbing solution and should be kept in that solution when not in use. This is a 3-10% w/v solution of sodium sulphite in water. Although only small quantities are involved, this is potentially hazardous chemical and must be handled appropriately.

The Makareth DO cell needs to be removed from the storage holder and to be attached to the DO sensor head on the wet-end assembly. Do this as follows:

(i) Removing the *Makareth* DO cell from its holder



Wearing suitable protective gloves…

Unscrew the end cap of the cell storage holder taking care not to spill the solution inside. Take care not to allow contact between the holder and the Makareth DO cell.

Rinse the assembly with clean water to remove any storage solution.

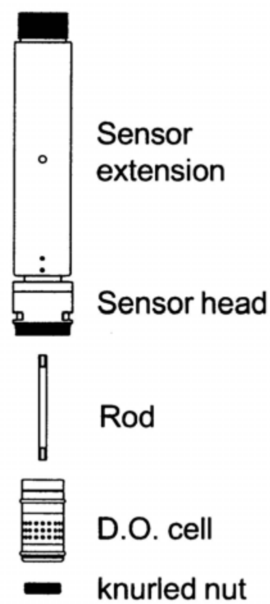
Hold the end cap in one hand and unscrew the knurled nut

Whilst holding the end cap in one hand grasp the cell with the other hand and firmly pull it away from the end cap.

Place the Makareth DO cell on a smooth surface.

Unscrew the rod protruding from the end cap.

(ii) Fitting the *Makareth* DO cell to the sensor head



Carefully screw the rod into the bottom of the sensor head.

Carefully slide the Makareth DO cell onto the rod, align the contact pins and push firmly home.

Screw the knurled nut onto the bottom of the Makareth DO cell

Finally, inspect the membrane for damage and replace if necessary.

Figure 38 - Diagram showing the fitting of a Makareth cell

10.4.2 Makareth Cell – membrane replacement

1) Remove the Makareth DO cell from the sensor head. Follow the same method that is described for removal of the cell from its holder.

2) Remove the two "O" rings retaining the membrane and set these aside.

WARNING

DO NOT USE TOOLS FOR THIS PROCEDURE

3) Remove the damaged membrane – do not use tools for this since this may damage the Makareth DO cell.

4) Cut a 120mm length of membrane. The membrane is flat at this stage, so carefully separate the layers by sliding one layer against the other using the thumb and first finger until the membrane becomes tubular in shape.

5) This tube of membrane must be stretched at one open end so that it can slide easily onto the Makareth DO cell. To do this open one end of the tube and gently stretch the membrane around its circumference. To prevent the membrane from being split use the first finger and thumb of both hands to stretch only short distances of membrane.

6) Lubricate the Makareth DO cell with a little water. Hold the sensor head firmly in one hand and carefully slide the stretched end of the membrane over the end of the Makareth DO cell. Now slide the membrane along the Makareth DO cell. To do this wrap the other hand around the membrane on the Makareth DO cell and push it towards the top of the Makareth DO cell. Ensure that the membrane is above the top-trimming groove.

7) Slide the bottom "O" ring onto its location groove.

8) Slide the top "O" ring over the bottom "O" ring, along the membrane and onto its location.

9) Trim off excess membrane by sliding a sharp knife along both trimming grooves.

10) Examine the new membrane carefully. If you suspect the membrane has sustained any damage during fitting or handling, then the procedure should be repeated. If it is cold, it may help to put the cut membrane into a little warm water before trying to fit it to the DO cell.

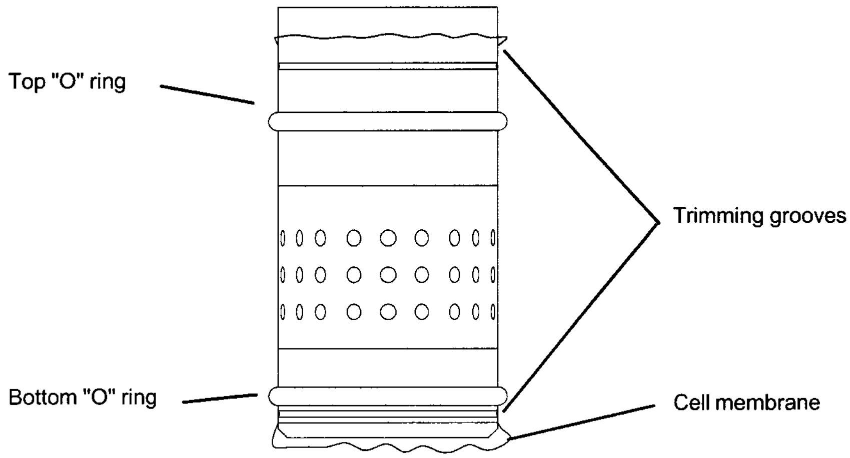


Figure 39 - Drawing of a Makareth cell with membrane ready to be trimmed.

10.4.3 Fitting a new Clark cell

The Clark cell is replaced as a complete unit. It cannot be re-membraned. Remove the retaining ring from the sensor head using the special tool provided. Remove the Clark DO cell.

Use a dry tissue to remove any moisture and old silicone grease from around the cell aperture. Unpack the new Clark DO cell and install it into the sensor head, ensuring that it locates into its mating parts correctly.

Screw the retaining ring over the Clark cell, taking care not to damage the Clark cell membrane. Use the special tool provided. Tighten the retaining ring firmly, but do not overtighten it.

Figure 40 - Photograph showing Clark cell assembly

Figure 41 - Photograph showing Clark cell components

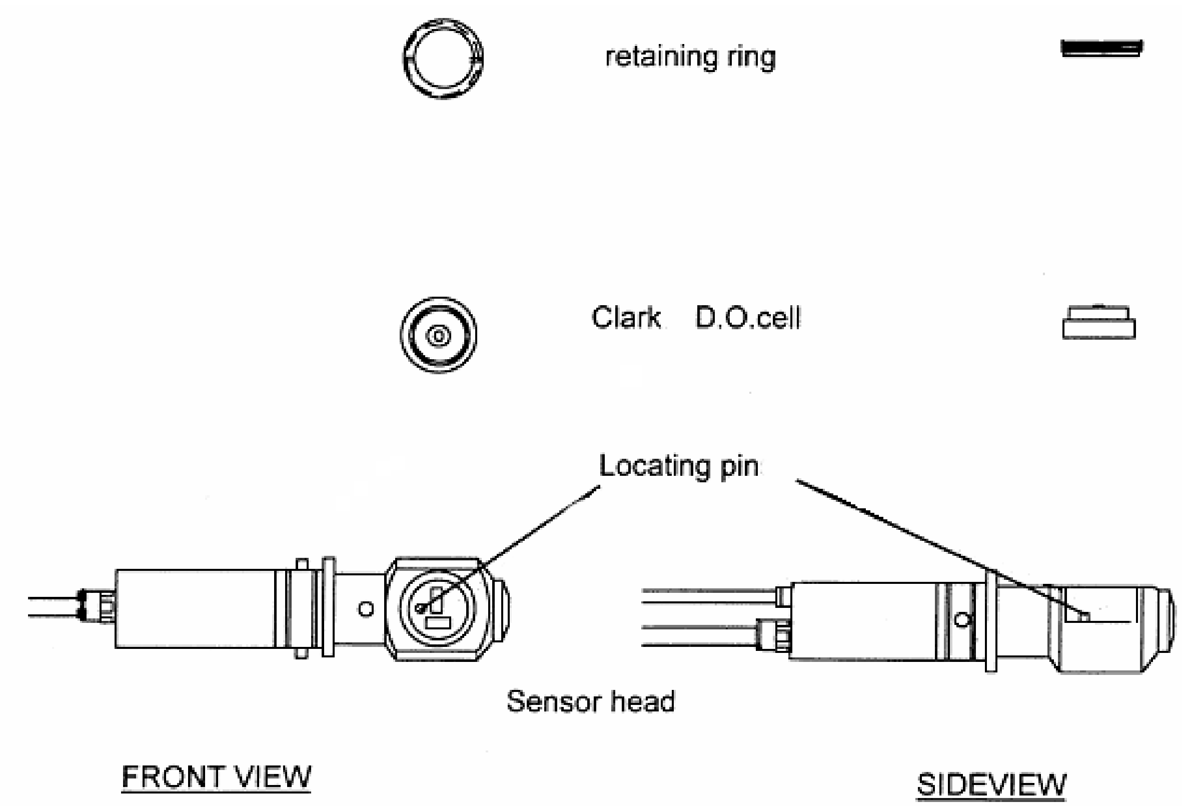


Figure 42 - Drawing showing Clark cell components

10.4.4 Changing the DO cleaning brush

Observe all safety and hygiene precautions before handling the wet end assembly. The calibration shroud or ball is supplied with a cleaning brush fitted in the bell mouth. The brush is located in a groove, secured by its own spring pressure. It can be easily removed by hand if necessary after removing the shroud or ball.

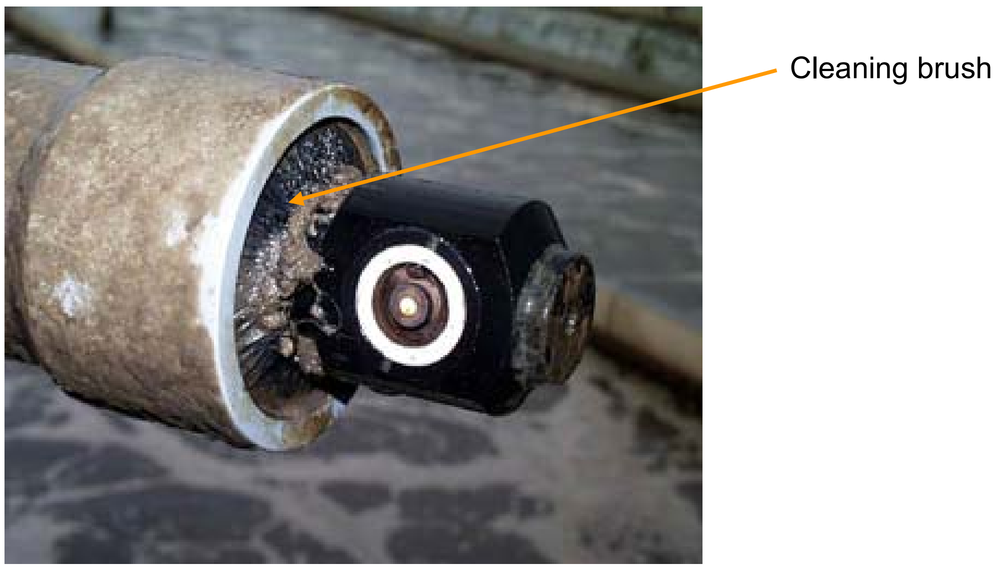


Figure 43 - Photo showing cleaning brush (Clark cell wet end)

10.4.5 Re-fitting the DO calibration shroud/ball

Slide the shroud or ball over the sensor assembly taking great care to avoid contact with the cell membrane. Ensure that the "O" ring seal is against the pneumatic cylinder and tighten the retaining nut by hand.

WARNING

DO NOT USE TOOLS

Reconnect all air lines and test for leaks.

Again, it is important that the fragile cell membrane is not damaged in any way. The DO Probe Assembly should then be returned to its normal operational position.

10.4.6 Returning to normal operation

Following the installation of a new cell/membrane the system must be recalibrated. To do this:

- Enter the 1234 menu and use the Probe Submenu to first tell the instrument that it has been fitted with a new or re-membraned cell (2.NEWCART)

- Then instruct it to trigger an autocalibration (1.AUTOCAL).

- Finally, QUIT the menu.

[Section spacer page]

11 Fault Diagnosis

The ***AZTEC DO system*** provides a reliable dissolved oxygen measurement over long periods. The self-cleaning and autocalibrating sensor gives a high degree of confidence in its performance.

Generally speaking, if the instrument accepts its autocalibration then the reading and outputs will be correct.

If the latest autocalibration was satisfactory then a '=' sign will appear on the right hand side of the LCD. If it fails a calibration then the '=' will change a letter or '?'

a = one failure
b = two consecutive failures
c = three consecutive failures etc, up to f

Above six failures ('f') will result in a '?' (unless changed via the 'CSC' comms command)

☞	Failure of a calibration does not necessarily mean that an instrument is not giving the correct reading; it merely means that the criteria set for acceptance were not met last time a calibration was attempted.

If failures start to occur you should take steps determine the cause and rectify any problems.

Often this can be divined by simply watching the operation of the instrument or removing the sensor from the process and visually examining it. Additionally there are several diagnostics tools that may be used to assist in this task (see the following pages).

11.1 Potential faults and their causes:

SYMPTOM	CAUSE
1. Loss of display	No power Mains line fuse blown Blown fuse in instrument power supply board Ribbon cable loose Faulty display
2. Poorly legible characters	Contrast control incorrectly set (a multi-turn potentiometer on left hand side of the LCD PCB assembly)
3. Cylinder not moving	Incorrectly fitted pneumatic connections Compressor not running – fuse blown or motor burnt out Low air pressure – incorrect relief valve setting on compressor or compressor diaphragms ruptured Cylinder seized, seals worn
4. Cell fouling rapidly	Cleaning brush needs replacement

11.2 Event Time Stamps Accessible via the Front Panel Display.

These are viewed by entering the password 2512. A list of code numbers will then be displayed together with the time and date. Each code number represents a certain event, not necessarily a fault. A copy of some of the relevant AZTEC ETS codes is included overleaf. It should be noted that not all of these apply to the DO system. Non-acceptance of a calibration is caused by one of five criteria being unsatisfactory.

a.	Degree of correction needed too large …..	ETS 211 / 221
b.	Output from sensor/head amp too low …..	ETS 212 / 222
c.	Signal too noisy …..	ETS 213 / 223
d.	Equilibrium at cal point not reached …..	ETS 214 / 224
e.	Autocalibration factor out of range …..	ETS 215 / 225
		head1 / head2

Potential causes of the above are as follows:

a. Fouled sensor; worn out or damaged sensor; change of cartridge with no 'NEW' instruction given to inform processor of such.
b. Fouled sensor; warn out or damaged sensor; faulty head amp card.
c. Damaged membrane; moisture ingress into sensor cable connectors.
d. Dirty or worn out cell.
e. As for a.

Event Time Stamps

AZTEC instruments log in memory the last 100 selected event messages. These can be viewed via the ‘2512’” - ETS menu on the front panel or via serial communications using a serial port connection and a terminal program. These messages are given below. Please note that not all messages are available on all instruments.

GENERAL EVENTS (All products)

0000	“NOT SET/UNKNOWN”
0009	“POWER-UP”
0010	“WATCHDOG RESTART”
0011	“RESTART” – Restart request
0013	“COLD START” – (after power up)
0014	“WARM START” – (after power up)
0015	“DATE/TIME REQ” – Request to change clock settings
0016	“DATE/TIME SET” – Clock settings changed.
0071	“RMESSAGING ON” – Report event messaging on
0072	“RMESSAGING OFF” – Report event messaging off

DO SPECIFIC EVENTS

0201	“HD 1 CALIBRATE” – Calibration request for first DO sensor.
0202	“HD 2 CALIBRATE” – Calibration request for second DO sensor. (if applicable)
0210	“HD1 CALIB OK” – Calibration success for first DO sensor.
0211	“HD1 XS CHANGE” – Calibration fail level 1 for first DO sensor. (step change too big.
0212	“HD1 LOW OUTPUT” – Calibration fail level 2 for first DO sensor. (signal too low)
0213	“HD1 XS NOISE” – Calibration fail level 3 for first DO sensor. (signal too noisy)
0214	“HD1 XS SLOPE” – Calibration fail level 4 for first DO sensor. (signal not stable)
0215	“HD1 XS ADJUST” – Calibration fail level 5 for first DO sensor. (autofactor too big/small)
0220	“HD2 CALIB OK” – Calibration success for second DO sensor. (if applicable)
0221	“HD2 XS CHANGE” – Calibration fail level 1 for second DO sensor. (step change too big.
0222	“HD2 LOW OUTPUT” – Calibration fail level 2 for second DO sensor. (signal too low)
0223	“HD2 XS NOISE” – Calibration fail level 3 for second DO sensor. (signal too noisy)
0224	“HD2 XS SLOPE” – Calibration fail level 4 for second DO sensor. (signal not stable)
0225	“HD2 XS ADJUST” – Calibration fail level 5 for second DO sensor. (autofactor too big/small)
0241	“HD1 MANUAL CAL” – Manual calibration request for first DO sensor
0242	“HD2 MANUAL CAL” – Manual calibration request for second DO sensor. (if applicable)
0245	“COMMS MAN.CAL” – Manual calibration request via comms port.
0251	“HEAD 1 CLEAN” – Clean request for first DO sensor
0252	“HEAD 2 CLEAN” – Clean request for second DO sensor. (if applicable)
0261	“HEAD 1 NEW” – New cell request for first DO sensor.
0262	“HEAD 2 NEW” – New cell request for second DO sensor. (if applicable)
0271	“HD1 ZDO SET” – Zero reset for first DO sensor.
0272	“HD2 ZDO SET” – Zero reset for second DO sensor. (if applicable)
0281	“HD1 USER CLEAR” – User clear of previous request for first DO sensor.
0282	“HD2 USER CLEAR” – User clear of previous request for second DO sensor. (if applicable)

0291	"HD1 STATS OVRD" – Statistics override of level 1 fail(s) for first DO sensor
0292	"HD2 STSTA OVRD" – Statistics override of level 1 fail(s) for second DO sensor. (if applicable)

Only if restricted event messaging is off (REM=0), which is the default.

8010	"RELAY 0 OFF"
8011	"RELAY 0 ON"
8020	"RELAY 1 OFF"
8021	"RELAY 1 ON"
8030	"RELAY 2 OFF"
8031	"RELAY 2 ON"
8040	"RELAY 3 OFF"
8041	"RELAY 3 ON"

8050	"HD1 AERATE OFF"
8051	"HD1 AERATE ON"
8060	"HD1 DOWN OFF"
8061	"HD1 DOWN ON"
8070	"HD1 UP OFF"
8071	"HD1 UP ON"
8080	"COMPRESSOR_OFF"
8081	"COMPRESSOR_ON"

8090	"DIG OUT09 OFF"
8091	"DIG OUT09 ON"
8100	"DIG OUT10 OFF"
8101	"DIG OUT10 ON"
8110	"DIG OUT11 OFF"
8111	"DIG OUT11 ON"
8120	"DIG OUT12 OFF"
8121	"DIG OUT12 ON"

8130	"HD2 AERATE OFF"
8131	"HD2 AERATE ON"
8140	"HD2 DOWN OFF"
8141	"HD2 DOWN ON"
8150	"HD2 UP OFF"
8151	"HD2 UP ON"

8160	"DIG OUT16 OFF"
8161	"DIG OUT16 ON"

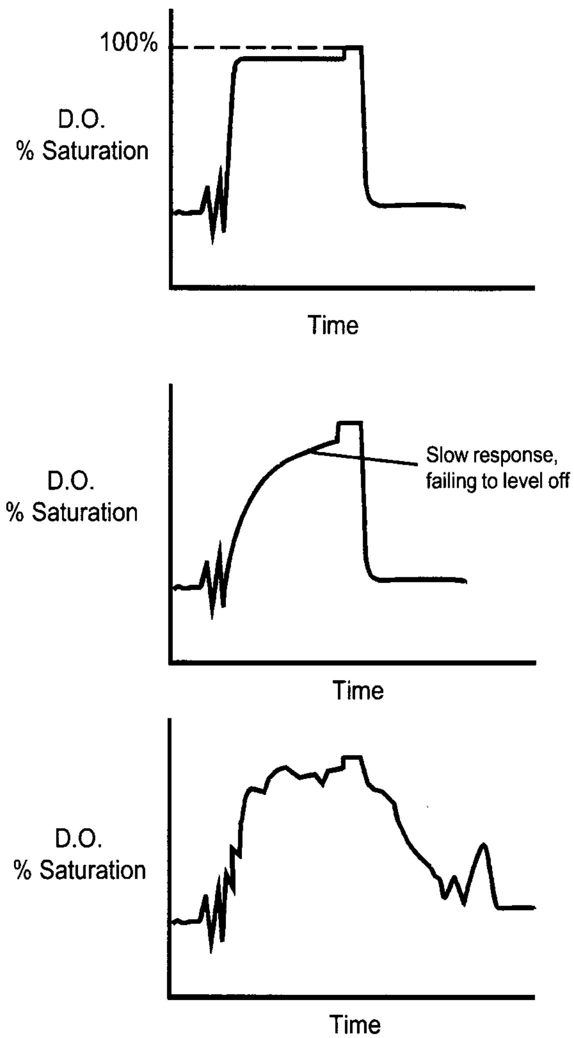
9010	"DIG IN1 OFF"
9011	"DIG IN1 ON"
9020	"DIG IN2 OFF"
9021	"DIG IN2 ON"

11.3 Detailed area graphs and 15-minute average data graphs

These may be retrieved from the instrument onto a PC either locally, or remotely using a suitable modem and phone line. The 'FT' software is required to retrieve this data and the 'GFX' program is required to manipulate the retrieved data and view it graphically.

This graphical display on sensor performance gives a more detailed and rapid method of interpretation and identification of potential faults.

The following examples of the general form of detailed data that might be recorded at auto-calibration time are instructive.



Perfect calibration graph

Dirty or exhausted cell

Damaged cell or moisture in contacts

Figure 44 - Example calibration detailed area graph shapes

Additional useful information can be gleaned from examining daily data graphs over a period. For example….

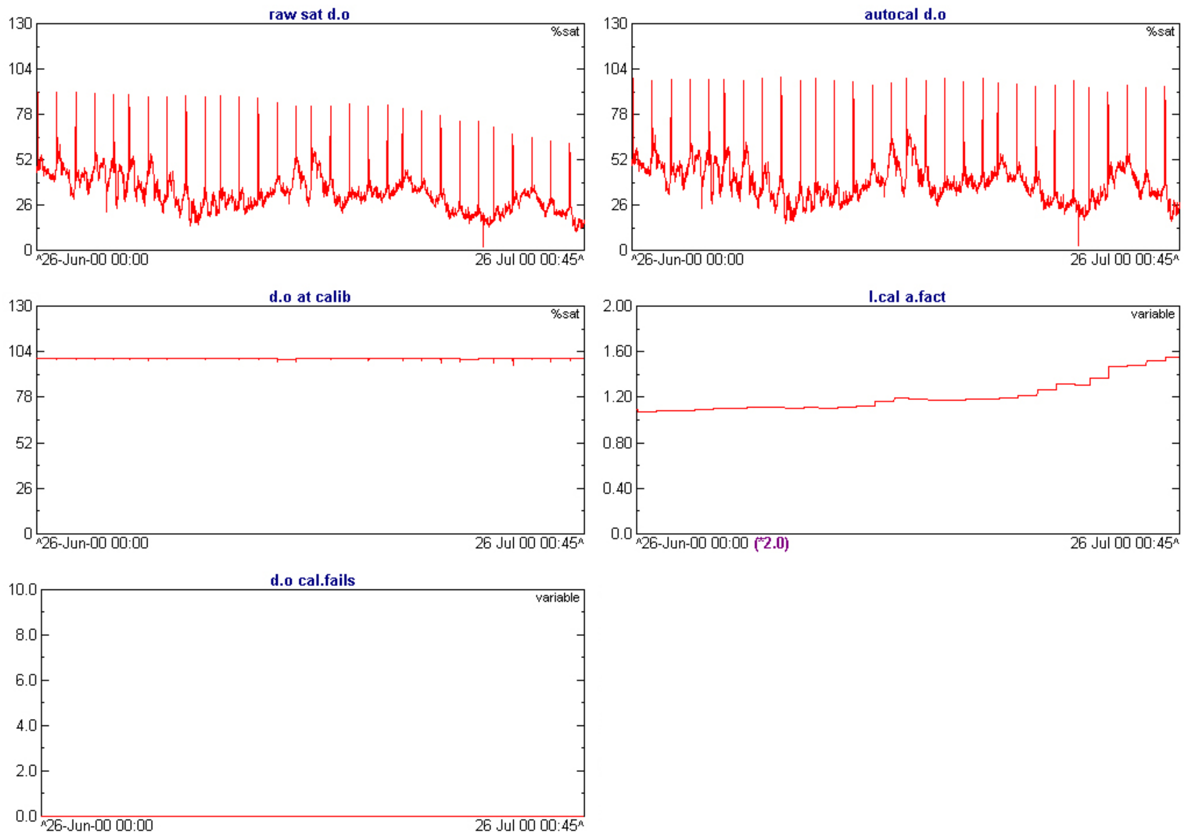


Figure 45 - Illustrative Daily data from an AZTEC DO sensor experiencing fouling

This is an example from real life where a sensor had been working for 3 months since its last inspection but was seen to be slowly fouling despite the automatic cleaning. This could be divined because the data from the sensor was retrieved and examined daily. The spikes on the 'raw sat do' are getting smaller showning the output from the cell when exposed to air is falling, presumed due to fouling because the detailed areas still showed a reasonably fairly rapid response to change in DO although slower than 'normal'. The 'autocal DO' spikes though are level, because the instrument is automatically compensating for the progressive fouling. The 'DO at calib' is nice and steady confirming auto-compensation is effective. The 'l.cal.a.fact' is getting progressively bigger, showing more and more compensation is having to be applied. The 'do cal fails' is zero throughout, showing that though there is fouling the instrument is compensating for it and the calibrations are succeeding – none failed.

By using the information above a visit to the instrument could be deferred, because though fouling, it could be seen the software was coping and compensating, so the measured DO was still accurate. When the site was visited and instrument was stripped down it was found the brush had worn and was not wiping the electrode as effectively as it should. Replacement effected an instant cure to the progressive fouling.

For experienced users additional extensive diagnostic information can be gleaned via some of the many serial communications commands described in section 9, including, but not restricted to…

- CST
- QST
- ACT
- CFQ
- EFQ
- CAL
- CAQ
- CIA
- CTY
- ETS
- CYC
- PMD

[Section spacer page]

DO APPENDIX A – CERTIFICATE OF CONFORMITY

A copy of the certificate of conformity is available on request from:

Severn Trent Services
8 Hawksworth
Southmead Industrial Park
Didcot
Oxon
OX11 7HR
UK

Tel: +44 (0)1235 512000 ◆ Fax: +44 (0) 1235 512020

email: salesenq@severntrentservices.co.uk

DO APPENDIX B – WARRANTY EXCLUSIONS

The ***AZTEC DO System*** is subject to the terms and conditions of **Severn Trent Services** general instrument warranty.

Because of their consumable nature, certain items are excluded from this warranty and are listed below.

- Air filters
- DO Cell/Sensor cartridge
- DO Sensor membranes and “O” rings
- “O” rings
- DO Cleaning brush

Unless a **Severn Trent Services** authorised engineer installs and commissions the instrument, **Severn Trent Services** has no control over the conditions under which any sensors are used and as such the warranty for wet end components is dependent upon correct installation, handling, usage and application.

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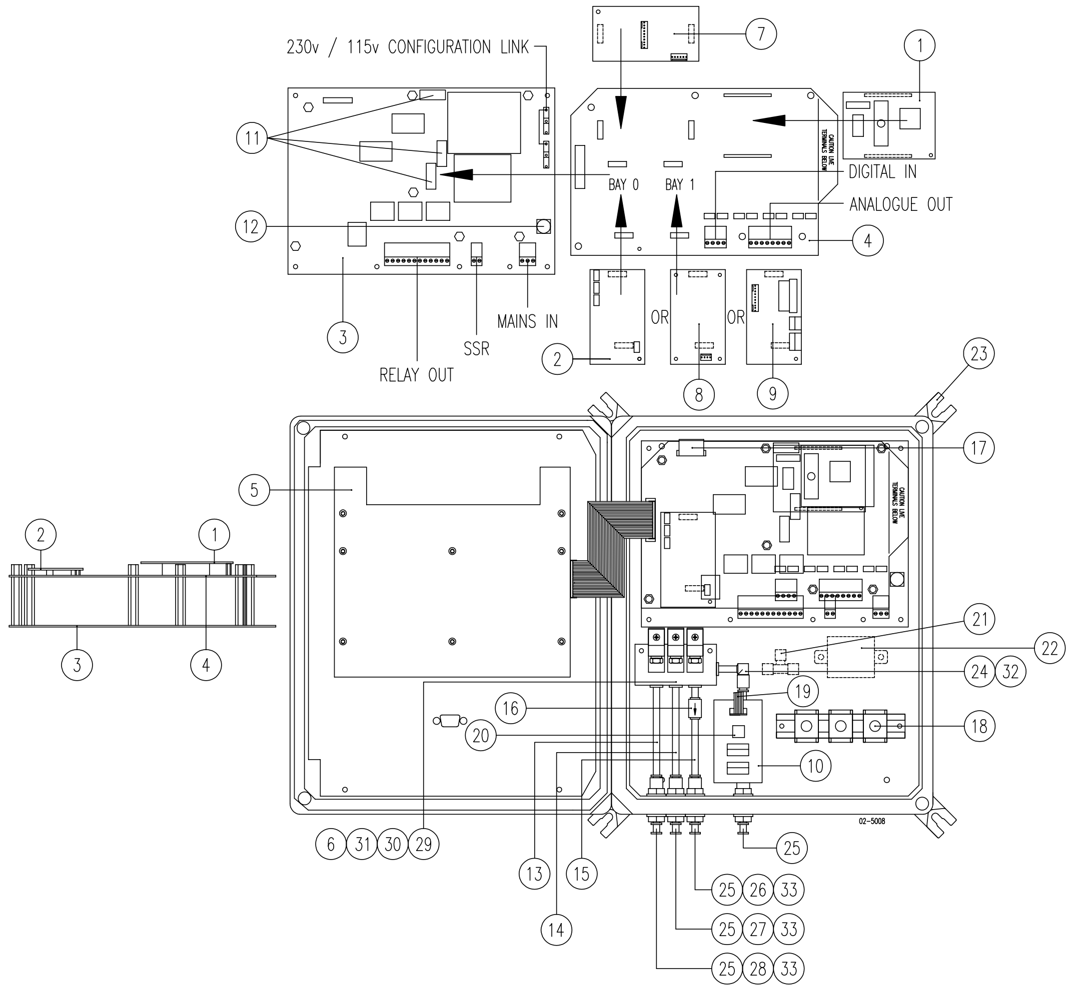
DO APPENDIX C – DO SPARE PARTS LIST



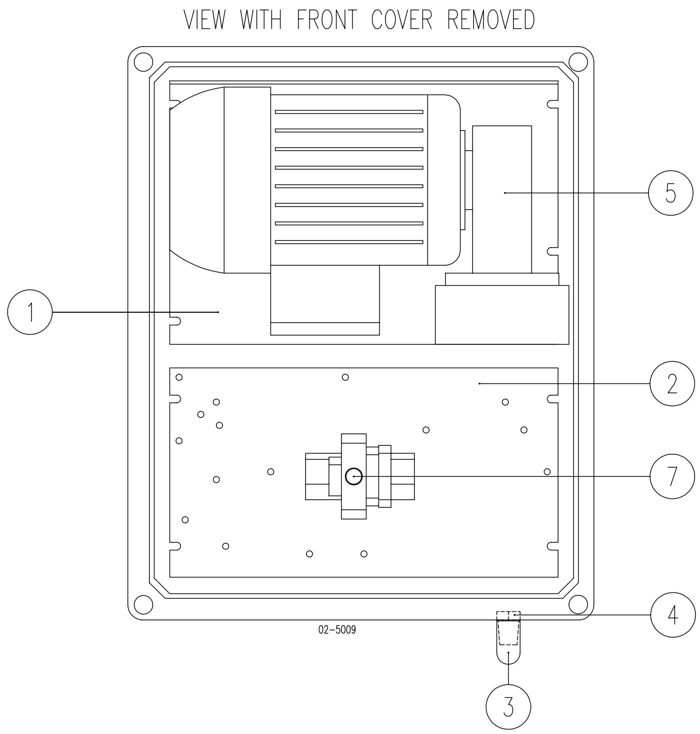
ITEM No.	DRG. CODE No.	DESCRIPTION	No. OFF
1	71-5024	MADOS V PROTEUS MODULE	1
2	71-5026	MADOS V DO/TEMP PRE-AMP ASSEMBLY	1
3	71-5034	MADOS V PSU & RELAY PCB ASSEMBLY	1
4	71-5035	MADOS V ANALOGUE M/BOARD ASSEMBLY	1
5	71-5004	FRONT PANEL	1
6	29-5004	VALVE c/w 3 SOLENOIDS & LED CAPS	1
7	71-5025	MADOS V RS485/DIGITAL I/O EXPANSION UNIT	1
8	71-5029	MADOS V/IV SWITCHABLE MLSS AMPLIFIER	1
9	71-5030	MADOS V MULTIFUNCTION I/O TERM BOARD	1
10	71-5028	MADOS V RS485 TERMINATION MODULE	1
11	60-5006	FUSE ANTI-SURGE 500mA	3
12	J60-0064	FUSE QUICK BLOW 250mA	1
13	26-5003	TUBE NYLON GREEN	A/R
14	26-5001	TUBE NYLON RED	A/R
15	26-5002	TUBE NYLON BLUE	A/R
16	29-0033	3.0 psi NON-RETURN VALVE	1
17	78-5021	MADOS V PSU/MOTHERBOARD CONNECTING CABLE	1
18	61-5000	CABLE CLAMP	3
19	78-5012	MADOS V COMMS RIBBON CABLE ASSEMBLY	1
20	71-5027	MADOS COMMS TERMINATION RESISTOR MODULE	1
21	25-0002	6mm EQUAL TEE LCB OPTION	1
22	54-5003	SOLID STATE RELAY COMPRESSOR OPTION	1
23	64-5007	WALL MOUNT BRACKET	4
24	25-5032	6mm PUSH FIT ELBOW	1
25	25-5020	6mm BULKHEAD	4
26	25-5087	6mm BULKHEAD COLLET BLUE	1
27	25-5088	6mm BULKHEAD COLLET RED	1
28	25-5087	6mm BULKHEAD COLLET GREEN	1
29	25-5000	COLLET BLUE	1
30	25-5002	COLLET RED	1
31	25-5001	COLLET GREEN	1
32	25-5003	COLLET YELLOW	1
33	25-5089	6mm PLUG	4

CONFIGURATION OPTIONS

PART No.	DESCRIPTION	ITEM No.	BAY 0	BAY 1
90-5036	SINGLE DO		2	–
90-5037	DOUBLE DO	7	2	9
90-5038	SINGLE MLSS		8	–
90-5039	DOUBLE MLSS	7	8	9
90-5040	SINGLE COMBINED DO/MLSS		2	8
01-5056	SINGLE DO c/w LCB	7	9	–
01-5059	SINGLE MLSS c/w LCB	7	9	–

NOTES

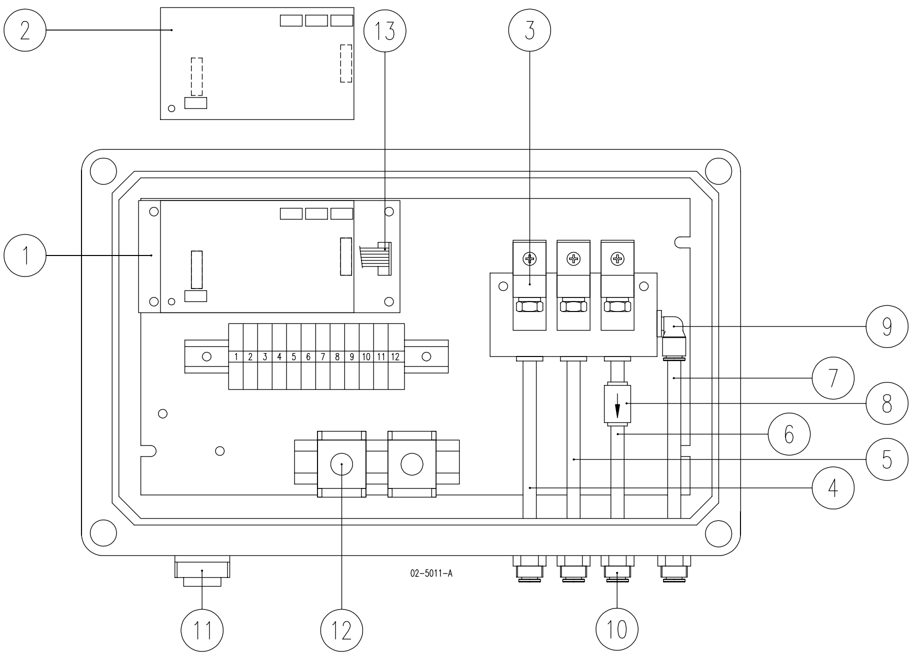
1. FOR REMOTE COMMS. OPTION BOARDS 7 AND 10 ARE INCLUDED.
2. ITEM 21 INCLUDED WITH LOCAL CONTROL BOX OPTION.
3. ITEM 22 INCLUDED WITH COMPRESSOR OPTION.
4. ITEM 23 NOT INCLUDED WITH PRE-WIRED BACK PANEL OPTION.



ITEM No.	DRG. CODE No.	DESCRIPTION	No. OFF
1	03-5001	COMPRESSOR BACKPLATE	1
2	03-5014	UNIVERSAL BACKPLATE - DO UNIT	1
3	25-5021	MUFFLER 1/4" BSP	1
4	32-5000	MUFFLER BRONZE	1
5	32-5001	110v COMPRESSOR	1
6	32-5002	240v COMPRESSOR	1
7	60-5009	FUSE 1 x 1/4" 5A	1

FOR FULL ASSEMBLY DRAWING OF 110v VERSION SEE 01-5034.
FOR FULL ASSEMBLY DRAWING OF 240v VERSION SEE 01-5035.

SERIES 5000 Compressor Assembly



FOR FULL ASSEMBLY DRAWING SEE 01-5058

ITEM No.	DRG. CODE No.	DESCRIPTION	No. OFF ASSEMBLY a	b	c
1	71-5031	LCB DO AMP ADAPTOR ASSEMBLY	1		
2	71-5026	MADOS V DO/TEMP PRE-AMP ASSEMBLY	1		
3	29-5004	VALVE c/w 3 SOLENOIDS & LED CAPS	1		
4	26-5003	TUBE NYLON GREEN	A/R		
5	26-5001	TUBE NYLON RED	A/R		
6	26-5002	TUBE NYLON BLUE	A/R		
7	26-5003	TUBE NYLON BLACK	A/R		
8	29-0033	3.0 psi NON-RETURN VALVE	1		
9	25-5023	ELBOW COMPACT STEM 6mm	1		
10	25-5020	6mm BULKHEAD	4		
11	53-5002	SIX PIN PANEL PLUG	1		
12	61-5000	CABLE CLAMP	2		
13	78-5013	MADOS V DO OUTPUT RIBBON CABLE ASSEMBLY	1		

SERIES 5000 DO LCB Assembly

DESCRIPTION	CODE
DO Sensor Head Assembly (does not include Clark Cell)	01-5000
Local Control Box (spare to replace in existing installation)	01-5030
Handrail Bracket Assembly	01-5031
Handrail bracket adaptor (for small diameter handrails)	03-5025
Clark DO Cell Removal Key	03-5012
6mm In Line Push Fit Pneumatic Connector	25-5009
Muffler ¼" BSP	25-5021
6mm x 1/8" BSP Pneumatic Connector	25-5028
6mm Red Nylon Air Tube	26-5001
6mm Blue Nylon Air Tube	26-5002
6mm Green Nylon Air Tube	26-5003
Non-Return Valve	29-0033
Sintered Bronze Filter	32-5000
Compressor (110V)	32-5001
Compressor (230V)	32-5002
Pneumatic Cylinder 80mm	32-5009
Annular Cleaning Brush	35-5001
Compressed Relay, 5A Solid State Relay, 24v	54-5003
500mA Anti-Surge Fuse	60-5006
5A Mains Fuse, 1" x ¼"	60-5009
Proteus CPU Card	71-5024
RS422 Digital I/O Expansion Card	71-5025
DO/Temp Amplifier Card	71-5026
Multifunction I/O Termination Board	71-5030
Amplifier Adaptor Assembly	71-5031
P.S.U. and Relay pcb Assembly	71-5034
Analogue Motherboard Assembly	71-5035
Dissolved Oxygen (Clark Cell)	77-5009
Cable, 10m with head for Clark Cell (no sensor included)	78-5000
Cable, 5m with head for Clark Cell (no sensor included)	78-5001
Cable, 20m with head for Clark Cell (no sensor included)	78-5002
Cable 15m, with head for Clark Cell (no sensor included)	78-5004
Formazin Turbidity Unit (FTU) Calibration Solution	80-0022
250mA Quick Blow Fuse	J60-0064

NB. When ordering spares for Aztec Series 5000 instruments, consideration must be given to the Wet End version (DO? or DO/MLSS?) as the input amplifier, sensor connecting cable and sensor head ordered may be incompatible with your equipment. For instruments with MLSS or combined DO & MLSS, spares part numbers are given on page 306

Similarly, spares for instruments employing Makareth DO cell technology can be found overleaf.

Spares for Systems Employing Makareth Cells

Dissolved Oxygen (Makareth) Silver Cell (repaired)	77-5000
Dissolved Oxygen (Makareth) Silver Cell (new)	77-5001
Makareth Cell Membrane Kit	775005
Cable, 5m with head for Makareth Cell (no sensor included)	78-5003
Cable, 10m with head for Makareth Cell (no sensor included)	78-5018

DO APPENDIX D – SOFTWARE LICENCE AGREEMENT

SOFTWARE LICENCE AGREEMENT ("AGREEMENT")

Severn Trent Services (“STS”)

STS grants to you and you accept a license to use the programs and related materials delivered with this AGREEMENT, ("PRODUCT").

STS retains the copyright protection of PRODUCT. Under copyright laws, you agree not to transfer PRODUCT in any form to any party without prior written consent of **STS**. Further, you agree that copies of PRODUCT shall be made only for backup and archival purposes. You must retain all such archival copies in your possession and reproduce the copyright notice from the original disks, if provided, on all such copies.

Except as provided in this AGREEMENT, you may not transfer, sub-license, lease or rent, time-share or lend PRODUCT, your copies, or the related materials or any of your rights under this AGREEMENT except by prior written consent from **STS**.

You may not alter, decompile, reverse engineer, disassemble, or reverse translate or in any other way derive any source code from PRODUCT. You may not remove or obscure **STS's** copyright and trademark notices in either hardcopy or machine-readable portions of PRODUCT.

STS warrants the physical media on which PRODUCT is distributed to be free from defects in material and workmanship and shall replace any such media free of charge for twelve months from date of delivery.

The invalidity or unenforceability of any provisions of this AGREEMENT shall not affect the remaining provisions hereof.

This is the only agreement between you and **STS** relating to software or firmware. It cannot and shall not be modified unless in writing and signed both by you and an authorized officer of **STS**. When you accept delivery it is an act whereby you agree to be bound by this mutual agreement between you and **STS**.

***** ADDITIONAL SECTION FOR MLSS in DO-MLSS *****

Additional information for

MLSS in SERIES 5000

DO/MLSS

Dual-function Instruments

[Spacer page]

12 MLSS in DO/MLSS equipment - INTRODUCTION

12.1 Scope

The combination DO-MLSS products are based on the ***AZTEC Series 5000 Dissolved Oxygen System*** platform. The range shares common components, software and procedures and the MLSS sensor is incorporated into the DO/temperature sensor assembly in the wet end. This section of the handbook details any additional MLSS-specific features of this product range. It should be read in conjunction with the main AZTEC DO System section of the manual, chapters 1 to 11, which contains the main operational information.

All safety, installation and technical references in the AZTEC DO manual section apply.

12.2 Product Range

The combination DO-MLSS product range currently comprises:

1. Single DO + MLSS.
2. Single DO + MLSS with Local Control Box (LCB)

12.3 Intended Audience

This manual is for reference by all specific, operational or engineering staff using the equipment.

12.4 Measurement Principles

The measurement of MLSS is made using an optical sensor. The wavelength of light used for the measurement is 870 nanometres (Infra Red). The light emitted by the sensor is invisible to the human eye. The light output is pulsed to prevent any possible interference from ambient sources such as variable sunlight. The Principle of operation of the AZTEC MLSS Sensor is based upon a technique called Nephelometry. A Nephelometer measures light reflected by solid particles in suspension in a liquid. The light is emitted by an infra red LED light source, and the light intensity is carefully controlled. The higher the concentration of solids in suspension, the greater the amount of reflected light. In this way, the intensity of reflected light is used to indicate the amount of solids surrounding the sensor.

The unit of measurement for nephelometric measurements is the Formazin Turbidity Unit or FTU. Formazin is available as a “Standard” solution that has a reproducible particle size and “brightness” or reflectivity. This standard is used to initially calibrate the sensor and amplifying electronics in the factory. The instrument is shipped accurately calibrated in FTU.

For on-line measurement of bio-solids, there are many variables that can affect the intensity of the reflected light. Each must be accounted for in producing a reliable measurement. The optical (reflective and absorptive) characteristic of sludge is not constant. Changes in the nature and characteristics of the sludge need to be accounted for in the measurement. In addition, the unit of measurement for MLSS is mg/L, not FTU. MLSS – Mixed Liquor Suspended Solids - is by definition a measurement of suspended solids concentration and as such can only be measured by filtration and weighing the dried solids filtered out from a known volume of liquor. This cannot be practically turned into an online continuous measurement. Available online optical instruments rely on having a known relationship between FTU and MLSS. With the AZTEC instrument, when the instrument is shipped, the value of FTU and mg/L is set as being identical. THIS IS AN ARBITARY SETTING AND HAS NO BEARING ON THE ACTUAL CONCENTRATION OF ANY BIO-SOLIDS IN YOUR PROCESS.

Part of the commissioning process involves taking a sample of the activated sludge from the vicinity of the sensor, noting the value the instrument "sees" in units of FTU when the sample was taken and performing a gravimetric analysis to determine the actual concentration of solids in milligrammes per litre (mg/L). The two sets of figures derived by this process are then applied to the instrument in the SETMGL option of the SETUP MENU "3333" – see page 293.

This calibration procedure will result in a reliable measure of MLSS concentration AT THE TIME OF CALIBRATION.

As previously mentioned, the optical nature of the sludge varies with time. The rate and magnitude of this variance is itself a variable and cannot be predicted by the instrument. These changes can be caused by any of a number of process variables such as loading, wastage rate, temperature and feedstock variations. For continued accurate performance, the MLSS measurement will need to be recalibrated periodically. The frequency of recalibration will need to be determined by observation of subsequent calibrations. If large changes are observed as a result of calibration, the frequency may need to be increased. Conversely, if subsequent calibrations show little change, it may be possible to decrease the frequency of recalibration. A useful starting point might be once every two weeks.

13 MLSS extension to DO - TECHNICAL SPECIFICATION

This describes the *ADDITIONAL* features added by the MLSS sensor to the basic DO instrument and should be read in conjunction with Section 4 - DO TECHNICAL SPECIFICATION on page 15.

WET-END ASEMBLY – MLSS Components

ITEM	DESCRIPTION
Sensor	Reflective system comprising IR optical call and source reference.
Mounting	Wet-end assembly secured to handrail or equivalent via pole and lockable quick release bracket.

Figure 46 - Specification for wet end MLSS and MLSS extension to DO instrument

[Spacer Page]

14 DO-MLSS OPERATION

The ***AZTEC combination DO-MLSS System*** adds MLSS measurement capability to the DO instrument. There are additionally standalone MLSS products – without DO and Temperature measurement. This document is designed for the combination DO-MLSS instrument but can be used for a standalone MLSS instrument by ignoring DO-specific references.

As with all similar commercial optical instruments the solids sensor actually measures the turbidity in the measured medium. The relationship between turbidity and suspended solids needs to be established by the user by periodic manual sampling and laboratory tests. This information is then fed into to the instrument and it is then able to report to the user SUSPENDED SOLIDS by multiplying the measured FTU by the supplied conversion factor. Though the primary measurement is turbidity, as with other products the sensor is described as an 'MLSS sensor', the assumption being made that this relationship is initially established and periodically checked and re-established when necessary.

The incorporation of an MLSS sensor into the DO assembly wet end adds the capacity for reliable and accurate measurement of Mixed Liquor Suspended Solids (MLSS) concentration to the DO measurement.

The combined unit executes software that:

- Sequentially controls the equipment involved in the combined sensor cleaning and DO calibration cycles.
- Processes sensor signals to provide the following additional measurements to those for the DO part of the instrument:
    - TURBIDITY FTU
    - SUSPENDED SOLIDS (SS) (mg/L) (N.B. Requires calibration and periodic recalibration to establish and refresh FTU:SS ratio)
- Provides detection of alarm states
- Enables detection of malfunctions
- Provides the maintainer with prompts, display of measured value, operational overrides and an environment allowing user-defined parameters to be set (alarm levels, calibrations, etc).

The first three actions are carried out during the normal mode of operation.

The last action is carried out via the Front Panel Interface keypad.

At any time the ***AZTEC DO/MLSS System*** can be in one of three operational states:

- **Normal mode of operation**
- **DO autocalibration/SS check or sensor cleaning cycle**
- **Front Panel Operation (Local Mode)**

The majority of system time is spent in the **normal mode** of operation.

The three operational states are described in more detail as follows:

14.1 Normal Operational Mode

During the normal mode of operation, the ***MLSS*** extension to the DO software measures and generates several parameters in addition to some of those for already described for DO in section 7.1 Normal mode of operation on page 60. All these parameters and their values may be observed on the display of the front panel interface. By pressing 'ENT' or 'DEL' keys on the front panel interface the user may scroll through the displayed parameters. Typically for a combined DO-SS instrument these will be….

Raw SS signal ex amplifier (volts)
Turbidity
Held Turbidity
Suspended solids
Held suspended solids
Raw DO signal ex amplifier (volts)
Sensor Temperature
Autocal DO
Autocal held DO
Absolute DO
Absolute held DO

The parameters in bold are those added by the MLSS extension to the instrument. In addition to DO and temperature sensor signal processing during the normal mode of operation, the processor unit reads the signal from the MLSS sensor amplifier and from this signal generates others as follows:

'Raw' MLSS signal

This is the MLSS signal in volts as read directly from the MLSS amplifier circuitry. It has had no compensation for non-linearity nor for FTU:SS ratio applied.

'Turbidity ftu Signal'

The characteristics of the MLSS sensor are such that the output varies with turbidity, but this variation is not linear. Therefore the sensor output volts are passed through an inbuilt experimentally-derived look-up table to produce a true turbidity reading signal in FTU's. The measurement range for this signal is 0 - 15,000 FTU's. Beyond 15000 FTU, response to changes in FTU falls significantly, so 15000 ftu is the paractical usable upper measurement limit. Beyond this accuracy is limited.

‘MLSS mg/l Signal’

The Turbidity signal is converted to an implied s**uspended solids** signal in mg/L by using the ‘SETMGL’ conversion information, which has to be determined and set by the user (Please see the ‘3333’ menu). The default range of this signal is 0 to 15,000 mg/l and initially a 1:1 FTU:SS ratio is assumed by the software. This is almost certainly not the real ratio, so the indicated ‘suspended solids’ reading will not be accurate until the real FTU:SS ratio is determined and fed into the instrument. Furthermore this ratio is likely to change with process variations over time so this ratio needs to be periodically re-established. This is because the ratio between FTU and suspended solids is affected by things such as floc size, density and, to a lesser extent, colour. This varies from plant to plant, and often varies within a plant with time and process variations.

‘Held Turbidity and Held MLSS signals’

If the instrument is being used for aeration or sludge wastage controlling purposes, it is important that output current signals are not affected by autocheck, autoclean, maintenance or testing operations. Systems connected to analogue outputs assigned with **Held** signals will have their signals held at the values existing before any disturbance to the instrument occurs during these operations and released during normal operation.

Once all signals have been generated, they are checked against all the alarm settings as defined by the user and the appropriate alarms activated.

Any of the signals (and also those from the DO/Temperature sensors if applicable) can be selected to be directed to any of the 4 - 20 mA analogue outputs available on the system for passing on to other systems/devices.

14.2 DO-MLSS ‘Autocalibration’ and Clean Cycles

14.2.1 ‘Autocalibration’ Cycle – N.B. only DO is actually calibrated

In the combined DO-MLSS instrument the ‘autocalibration cycle’ is actually the DO calibration cycle. It is by default executed once per day during a non-critical period on or close to a preset base time. Because the sensor is a combined DO – Temperature – SS unit, when the DO is exposed to air for its autocalibration, so too is the suspended solids sensor. Therefore, for these instruments this section should be read in conjunction with the DO sensor autocalibration information – in particular section 7.2 “DO Autocalibration / Clean Cycle” on page 64.

During this cycle, the DO sensor is calibrated but the instrument does **NOT** calibrate the MLSS sensor. It merely exposes it to air. Depending upon the type of solids sensor, this *may* provide a signal that could be used by the user to check the cleanliness of the sensor. However, this only really applies to the early transmission-type sensors (The ‘type 1’ and ‘type 2’ sensors). These though have now been more or less totally superseded by the ‘type 3’ sensor – which works on reflectance. Additionally there is a ‘type 4’ sensor, which works on nephelometry.

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It is unlikely that examining the MLSS signal during the DO autocalibration period will provide any useful information on the cleanliness of current reflectance-type sensors and nephelometric-type sensors. However, the user may wish to check for themselves what effect autocalibration has on these signals to see if any useful information might be gleaned.

It is not feasible to actually automatically calibrate the MLSS sensor in situ. This would require two things:

- A suitable cheap, plentiful, reproducible and stable suspended solids standard
- A mechanism for exposing the in-situ sensor to a standard during the DO autocalibration period whilst still exposing the DO sensor to air

Neither of these is available or is feasible. The nearest thing to a reasonably stable reasonably priced 'suspended solids' standard solution is the Formazin ***Turbidity*** standard. There is no available suitable stable **suspended solids** standard.

The MLSS sensor and amplifier are set up and standardised in the factory using formazin turbidity standards. When deployed in the field the relationship between the FTU it reads and the actual suspended solids level present has to be established by the user and the instrument must be notified of this relationship so the software can convert the measured FTU to a 'suspended solids' value. This procedure is described under the '3333' Menu – 'SETMGL' procedure later in this section.

Initiation of an autocalibration/autocheck cycle

The autocalibration autocheck cycle is initiated:

- During normal operation, once per day changed by the user
- On power up, cold start (memory loss or not set up) or on power on, warm start (memory retained), and the calibrate-on-power-up flag is set.
- Via the keypad in the maintenance menu '9999'
- By contact closure of the relevant digital input
- On request via serial communications

Full details are given in section 7.2.1 "Autocalibration Cycle" on page 64. Please refer to this section for further information.

14.2.2 Clean Cycle

Full details are given in section "7.2.2. Cleaning Cycle" on page 67. Please refer to this section for further information. The DO and MLSS sensors are cleaned together.

14.3 DO-MLSS Font Panel Operation (Local Mode)

A keypad and display, located inside the Electronics Module, is provided for the local user to access a number of system facilities, full details of which are contained in *Section 8 Using the Front Panel Interface.*

The keypad is accessed by unscrewing two retention screws and opening the clear front cover of the module. Its layout is shown in the photograph below.

Note the Splitter/combiner box into which the lead from the DO/MLSS wet end plugs

Figure 47 - Main electronics module with integral compressor & optional mounting panel

Local Control Box (if applicable)

A local control box is installed adjacent to a remote AZTEC DO probe location. It is provided to house the sensor amplifier and pneumatics and allows for manual testing of cleaning and aerating functions. The layout is shown below:

Front View

DO connector MLSS Connector

View from Bottom

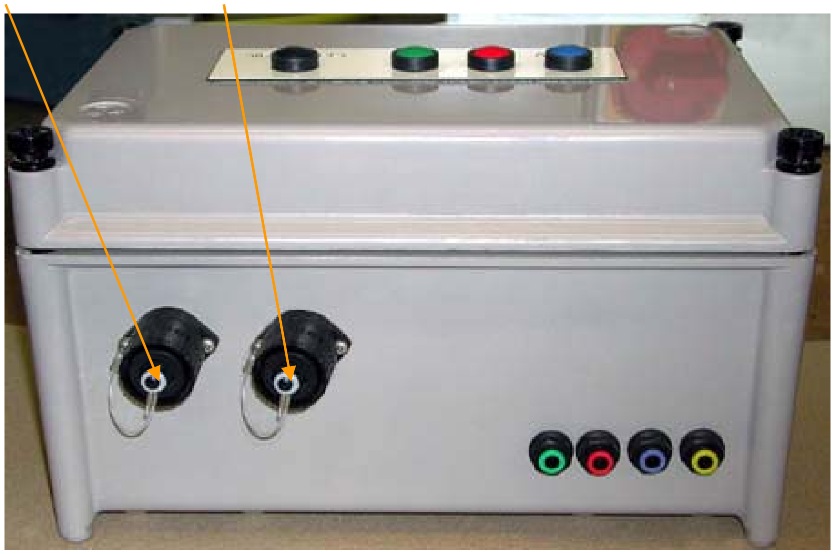


Figure 48 - DO-SS Local Control Box showing layout.

[Spacer Page]

15 USING THE FRONT PANEL INTERFACE

15.1 General Description

A keypad and display located in the Electronics module are provided to access several facilities available to the user. See Figure 47 - on page 286.

Using the front panel keypad and display it is possible to check the current state of the instrument and configure, test and alter its operation. This part of the manual describes how information may be observed and parameters altered using the front panel keypad and display.

When in normal operating the MAIN SCREEN is displayed as shown below:

```
'MSL_DO+' DATE=08/09/94 TIME=15:05:20 =
Suspended solids        520 mg/l
```

This represents a typical example of the MAIN SCREEN from an AZTEC DO/MLSS System. The screen consists of three main areas:

```
(A) Clock Display                 *
(B) Parameter Display
```

Alarm active * symbol

(A) **Clock Display/Status Line:** The local date and time settings are shown. The date and time may be altered using the general setup menu described later. The top line also shows action strings from time to time. The user is able to view the current action string by pressing '.' (dot / stop / period) on the front keypad.

(B) **Parameter Display:** This section displays the current readings measured by the system. The user may scroll through displayable parameters by pressing the '**ENT'** or '**DEL'** keys.

The *alarm active* * symbol is a diagnostic flag.

15.2 Menus Available via the Main Screen

This has already been described for the DO instrument in section 8.2 Menus Available via the Main Screen on page 73. A brief description will also be given here, but only those features added with the MLSS measurement addition or different to the DO-only instrument will be described in detail.

User menus may be accessed from the MAIN SCREEN. This is done by typing a unique passnumber that prevents unauthorised entry by casual users. There is no indication on the display of a passnumber being typed. If a mistake is made when entering a passnumber, then press a **non-numeric** key and retype the correct passnumber. Note that the **ENT** key does not need to be pressed after the passnumber has been entered.

1. **Installation Setup Menu:**

   This menu is entered by typing the passnumber **1234** on the front panel keypad. This menu allows the user to:

   (a) Alter the clock settings.
   (b) Access the manual control functions (via the *manual* submenu).
   (c) Define the probe/cell status (via the *probe* submenu).

2. **Outputs Setup Menu:**

   This menu is entered by typing the passnumber **8888** on the front panel keypad.

   This menu allows the user to:

   (a) Examine/configure setpoint values for alarm digital outputs
   (b) Configure any analogue outputs
   (c) Examine/configure setpoint values for group alarm digital outputs
   (d) Configure a "held MLSS" digital output for external control systems

3. **Instrument Specific Setup Menu:-**

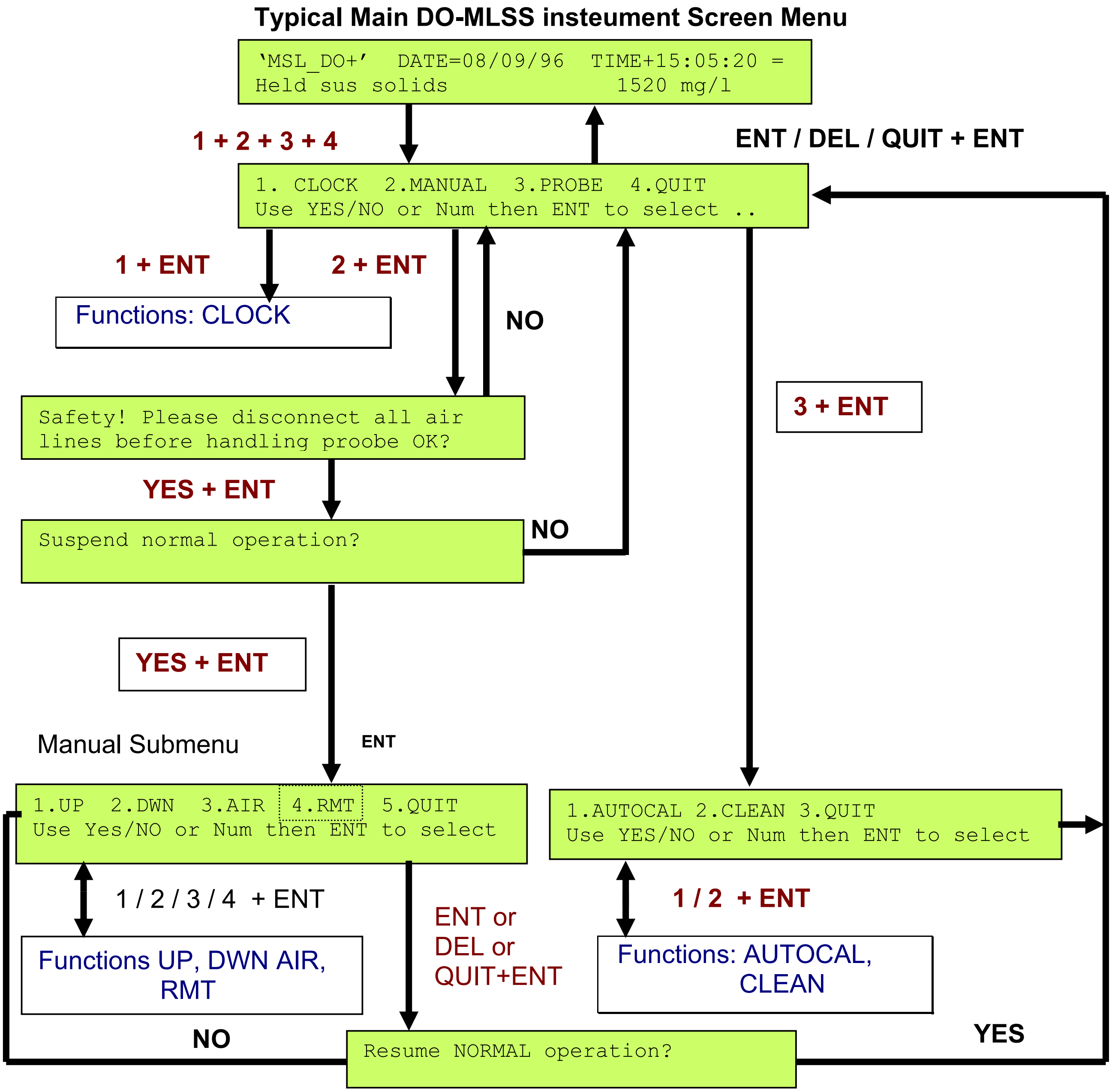
   This menu is entered by typing the passnumber **3333** on the front panel keypad. The options in bold below are specific to the MLSS feature. This menu allows the user to:

   (a) Set the DO autocalibration and DO-MLSS assembly exercise frequencies
   (b) Set the MLSS zero and smoothing level
   (c) Set the conversion ratio of FTU to mg/l

☞ There are other less frequently used menus accessible from the front panel. These are covered in full in the preceding main AZTEC DO Systems manual sections 1 to 11.

15.3 DO-MLSS Installation Setup Menu (Passnumber 1234)

This is virtually the same as for the DO-only instrument. Typing the passnumber '1234' on the front panel keypad enters this menu. The maintenance functions and clock display are accessed using this menu. It allows testing of the wet end assembly and/or setting up of the wet end assembly for DO calibration after maintenance. The following diagram shows how these functions may be accessed:



☞	** RMT (REMOTE) will not appear unless a local control box is installed.

15.3.1 Overview of functions accessed via the INSTALLATION SETUP Menus

Main Screen Menu:	**CLOCK, MANUAL, PROBE**
CLOCK:	Sets the system clock – required for data logging
MANUAL:	Access to manual submenu: **UP, DWN, AIR, RMT**
PROBE:	Access to Probe submenu: **AUTOCAL, CLEAN**
Manual Submenu:	**UP, DWN, AIR, RMT**
UP	Moves the probe up into the shroud/ball.
DWN (DOWN)	Moves the probe down into the process.
AIR (AERATE)	Force calibration airs past the DO/MLSS probe assembly (maximum duration 30 minutes).
RMT (REMOTE)	Enables the user to operate the UP, DOWN and AERATE functions from (if applicable) a Local Control Box adjacent to the remote MLSS probe.
Probe Submenu:	**AUTOCAL, CLEAN**
AUTOCAL	Allows the DO/MLSS autocal frequency to be set and requests to be made such that it is carried out as soon as possible.
CLEAN	Allows the clean frequency to be set and/or a clean request to be made such that is carried out as soon as possible.

These features are the same as for a DO only instrument and the user is referred to the section Installation Setup Menu – Detailed Instructions on page 79 onwards for full instructions on their use and features.

15.4 Instrument-Specific Setup (passnumber '3333')

This menu too is very similar to that for the DO-only instrument covered in section 8.5 Instrument Specific Setup Menu (Passnumber 3333) on page 101 to which you should refer. Only those differences that apply to the combined DO-MLSS will be described in detail here.

The menu is entered by typing the passnumber **3333** on the front panel keypad. It allows the user to initiate and set the frequencies of the DO autocalibration and the combined DO-MLSS sensor cleaning. **It also allows access for the more specific settings for the zero, signal smoothing and the conversion ratio of FTU to mg/l for a MLSS signal.**

When you enter this password, the display will change to something like…

```
1.DO_OPTS 2.SS_OPTS 3.QUIT
```

Selecting option 1 – 'DO_OPTS' accesses the DO options that let you configure the DO calibration type; the acceptance limits, statistics override limits, and cleaning and calibration frequencies. These are identical to those described in section DO instrument-specific setup menu – Detailed Instructions on page 103. Note that the cleaning frequency set by this menu route also applies to the MLSS sensor and the DO autocalibration frequency also affects the MLSS sensor since it causes it to be exposed to air for the same length of time as the DO sensor.

Option 2 – 'SS_OPTS' accesses the MLSS sensor options that display as:

```
1.SSS 2.ZSS 3.SETMGL 4.QUIT
```

1.SSS

Selecting option '1.SSS' lets you set the 'Suspended Solids Smoothing' – the number of readings, each 1-second apart, that are averaged for each new reported (displayed) suspended solids value. It is necessary to perform this average because otherwise the reading would appear to be changing rapidly, because of the effect of the air being supplied to the process. Selecting this option gives a display like…

```
Set SOLIDS SAMPLES for smoothing
010
```

The default value of 10 is normally acceptable. If required, change it according to your choice, then press 'ENT'. Press 'DEL' to return to the 3333 menu.

2.ZSS

Option '2.ZSS' allows the probe's output at zero SS to be changed. This should not normally be necessary but if required it will permit the user to physically adjust for any offset that the SS probe may be seeing from true zero. This will be adjusted for in subsequent operation

☞	Setting ZSS correctly involves removing the probe assembly from the process. This is why protective questions have been provided around the actual setting of ZSS so that control signals can be held so as not to adversely affect control systems during maintenance.

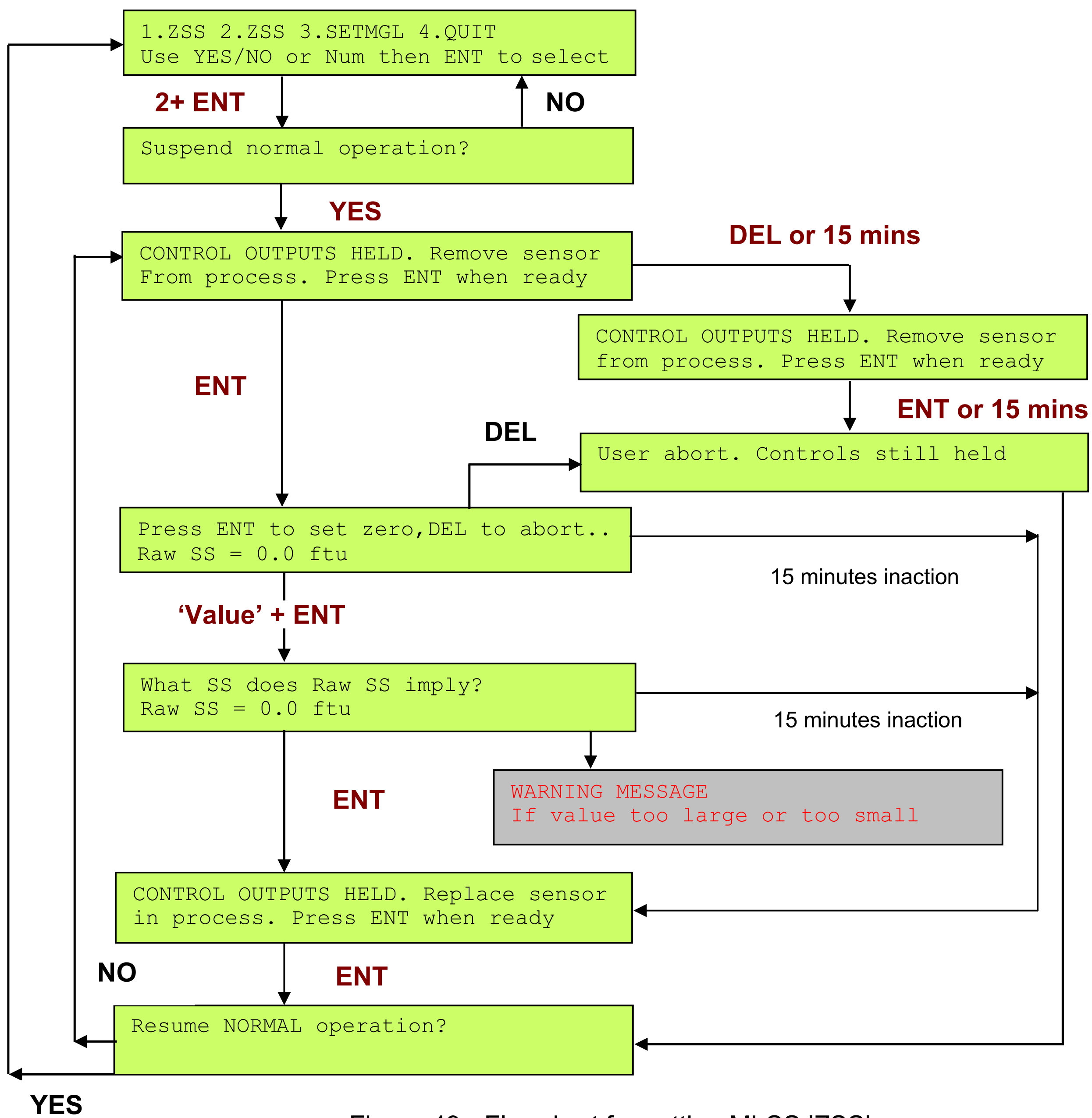


Figure 49 - Flowchart for setting MLSS 'ZSS'

☞	If both ZSS and SETMGL are to be altered, always change the ZSS first.

3.SETMGL

Option '3.SETMGL' lets the user enter the actual mg/l value of the mixed liquor suspended solids as determined by gravimetric analysis for a corresponding observed ftu value from the instrument made at the time the sample was taken. It requires the user to take a sample for laboratory gravimetric analysis, and to observe the indicated ftu at the same time. Later, when the lab analyses are known, the instrument should be told of the FTU shown when the sample was taken, and the lab analysis. Until this is done, the software assumes a 1:1 ratio, which is almost certainly not the real ratio, so **the FTU reading will normally always be accurate since that is what the sensor was calibrated in and actually measures; the MLSS mg/L reading will only be as accurate as the latest 'SETMGL' information fed in to the instrument by the user.**

The FTU:Suspended Solids ratio is likely to change with process variations. It should be established at installation time and re-established periodically as experience dictates, and the instrument should be informed of the changes using the SETMGL menu option or comms command. We recommend it be checked every two weeks initially, and if stable, it may be possible to reduce the frequency to once per month. It is unlikely to remain significantly unchanged for any longer than this.

Selecting option 3.SETMGL from the SS_OPTS menu of the '3333' instrument-specific menu for a DO-MLSS instrument allows the user to calibrate the MLSS sensor against a known sample of suspended solids:

1) Make a note of the ftu reading currently shown on the front panel. To do this use the DEL/ENT keys to scroll through the parameters displayed on the LCD until the turbidity measured in ftu's is shown. e.g.

```
'MSL_SS' DATE=25/02/03  TIME= 14:16:20
turbidity               7530 ftu
```

In the example above the reading at the time that the sample was taken for lab analysis is taken is 7530 ftu

2) Take a sample of the process liquor as near to the probe as possible. Determine the suspended solids in the sample by the standard method using gravimetric analysis. (This for example, may be 6000 mg/l).

3) When the gravimetric analysis result is known, go into the 3333 – SS_OPTS submenu and select option 3 (SETMGL). You will be presented with a screen similar to the one shown below:

```
Manual Cal:         FTU shown   MGL Actual
Suspended solids     10000        10000
```

This example shows the screen before any SETMGL has been applied – the software is assuming 10,000 FTU is equal to 10,000 mg/L (unlikely!).

4) Enter the ftu reading that was noted at the time of sampling (7530 in the example), and then the mg/L result of the gravimetric analysis (6000).

```
Manual Cal:         FTU shown   MGL Actual
Suspended solids    7530          6000
```

5) Press ‘DEL’ to return to the 3333 menu.

☞	If both ‘ZSS’ and ‘SETMGL’ are to be altered, always change the ZSS first.

This completes the description of the differences in the user-interface between a DO-only and a combined DO-MLSS instrument. The final points of difference relate to the additional serial communications, which loosely parallel the ZSS, ZDO and SETMGL features just described…

16 ADDITIONAL SS-related SERIAL COMMANDS

There are three additional serial communications commands added in the combined DO-MLSS product – SMG; SSS and ZSS. Their functions are as follows:

'SMG' Command

Command: **SMG**– **<u>S</u>**et FTU versus Suspended solids **<u>mg</u>**/l relationship

Purpose: A command for specialist users. It lets you read or change the ratio between formazin turbidity units (FTU), which is what a suspended solids sensor **actually** measures, and laboratory-determined true gravimetric suspended solids.

Unless this relationship is periodically checked and corrected, the 'Suspended Solids' measurement will be inaccurate, as will any other parameter that depends on it.

Keypad equivalent access: '3333.3.3' : Instrument specific menu, SETMGL submenu

Applies to: All instruments with 'suspended solids' (ftu) measurement	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	SMG or SMG {Head} if multiheaded instrument
Write:	SMG= {FTU shown} {mg/l actually determined} [head] Note: it is important to record the FTU displayed by the instrument or retrieved via the 'VAL' command at the time the sample was taken for later lab analysis.

Remarks:

The cold start default sets FTU and mg/l to be identical. This ratio is very unlikely to be correct, and until calibrated the suspended solids measurement will not be accurate. The ratio changes according to the range of solids being measured – it is not linear - and according to the nature of the solids. The size, nature and colour of the floc can all affect this ratio and this can change with time as plant conditions vary. We recommend this ratio be re-established initially weekly and the instrument be corrected via the SMG command or 3333 menu. This frequency can be modified in the light of experience, but probably should not be less than once per month.

Example:

Read:	`?SMG` `10000 10000`
Write:	`SMG=2500 3400`

The read example is that no correction is being made – the default 1:1 ratio is being used, which is probably wrong. The write example sets the instrument using the information that when a sample showed 2500 FTU, lab analysis showed its true gravimetric suspended solids content as 3400 mg/l.

See Also: **SSS; ZSS; DSP; XDSP**

'SSS' Command

Command: **SSS**– **S**uspended **S**olids **S**moothing

Purpose: To smooth suspended solids signals using a running average.

Keypad equivalent access: Via '3333' Instrument-specific menu and submenus

Applies to: All instruments featuring 'suspended solids' (ftu) measurement	**User knowledge:** Advanced
Type: Both Read and Write	**History:** Issued October 1996

Syntax:

Read:	SSS or SSS {Head} if multiheaded instrument
Write:	SSS={samples in running average}

Remarks:

Suspended solids signals are inherently noisy, usually because the medium in which the measurement is being made contains air bubbles, which affect the measurement. Some form of damping needs to be applied to these signals, and 'SSS' provides this. The cold start default sets SSS to 5 in a respirometer (10 in DO-MLSS), meaning 5 (10) samples will be taken and averaged before a new reading is reported. The sampling frequency is once per second, so the reading will be updated every 5 (10) seconds by default.

Example:

Read:	`?SSS` `10`
Write:	`SSS=5`

The read example is that 10 samples are taken and averaged. The write example reduces this to 5 samples.

See Also: SMG; ZSS

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‘ZSS’ Command

Command: ZSS - Raw input value at Zero SS concentration

Purpose: A command for specialist users. This command permits inspecting or modifying the offset of the reading of the suspended solids raw input channel at zero suspended solids (ftu).

N.B. This comms command works in RAW ADC input units, NOT engineering units.

Local Keyboard menu accessibility: ‘3333.3.1’ – Instrument specific menu & submenus

Applies to:	All instruments with solids sensor	**User knowledge:**	Advanced
Type:	Read and Write	**History:**	Issued October 1996

Syntax:

Read:	ZSS
Write:	ZSS= {RAW input value}[Head number if multiheaded]

Remarks: It is unlikely the solids sensor input channel zero offset will need changing. The instrument is designed for use in reasonably high solids media like mixed liquor and return activated sludge. If it is being habitually used at lower levels (1000 mg/l) and the user is concerned about discrepancies at these levels it may become an issue. Even then, the preferred method of calibrating and correcting zero solids (ftu) is the manual method that has been described in the main manual under the ‘3333.3.1’ submenu. Additionally the instrument should always be calibrated at around the solids concentration it is required to measure and should be used at its designed measuring range.

The solids sensor input channel is set up at manufacture to have a deliberate offset for the same reason that 4 - 20 mA signals are preferred to 0 - 20 mA signals - the ability to discriminate between a failed circuit and a true zero solids signal. The input card is 0 – 5 volts and the offset is made 0.5 V which is 4095/10 – i.e. 410 raw units

Example:

Read:	?ZSS 585
Write:	ZSS=570

See Also: SMG; SSS; ZDO

17 DO-MLSS ROUTINE MAINTENACE

The ***AZTEC DO-MLSS system*** will periodically require attention from maintenance personnel and has been designed to allow the user to easily and quickly diagnose when maintenance is required before the integrity of the data is impaired. Please refer to section 10 DO & DO-MLSS ROUTINE MAINTENANCE on page 249 for details on Health & Safety, Test Equipment and Programmed Maintenance for DO-only systems. **Section 10 also applies in full to the DO-MLSS combined instrument.**

17.1 Health & Safety

Please ensure that all safety matters detailed in the installation section are read and understood, before attempting to carry out maintenance work.

17.2 Test Equipment

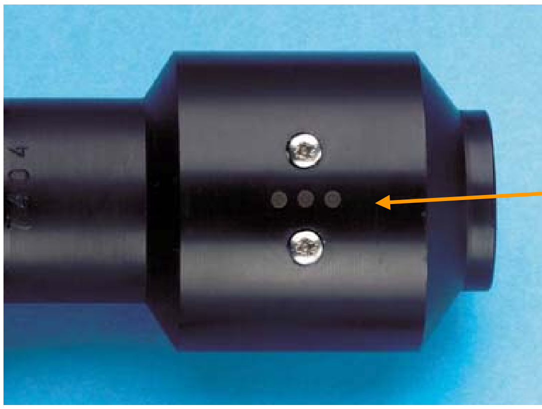
See *Section 5 Installation.*

17.3 Programmed Maintenance

The maintenance requirements for the DO-MLSS combination instrument are the same as that for the DO-only instrument. See section 10 DO & DO-MLSS ROUTINE MAINTENANCE on page 249 onwards.

17.4 Maintenance of the DO- MLSS Wet End Assembly

Section 10 DO & DO-MLSS ROUTINE MAINTENANCE on page 249 onwards has described the maintenance issues for DO-only instruments which also apply to the DO-MLSS combination. The only additional requirement is to check the solids sensor is being cleaned properly by the brush. The solids sensor is located diametrically opposite the DO sensor in the combination sensor assembly..



Optical detector and IR emitter lenses can be seen between the two screw heads.

Figure 50 - Combined DO + MLSS. sensor head showing MLSS components

The connection from the wet end assembly to the main electronics panel is different to that for a DO-only instrument.

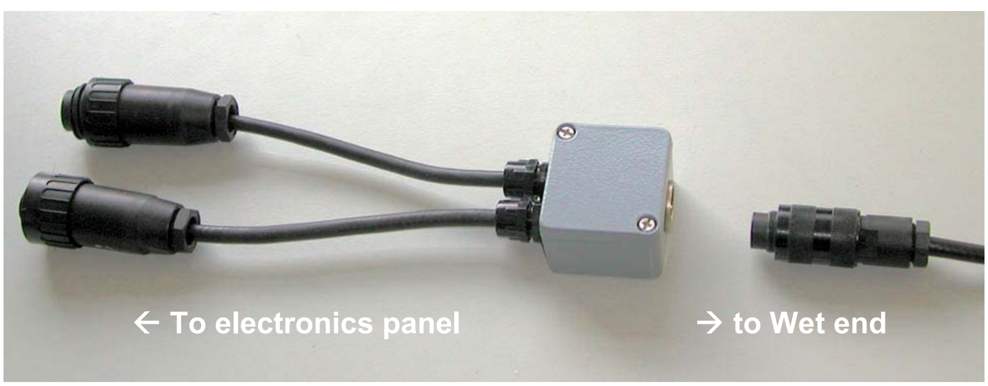


Figure 51 - DO-MLSS cable splitter fitted on main electronics panel

In all other normal respects all maintenance issues relating to DO-only apply to DO-MLSS and are covered in the DO section of this manual. The only exception is if for some reason either the MLSS amplifier or combined DO-MLSS head are replaced for any reason. Details of the necessary procedure follow.

17.5 MLSS Measuring System sensor head and amplifier

The MLSS system measuring components (the sensor head and the amplifier) are calibrated as a matched pair during manufacture. If either component requires replacement, they should both be replaced and if so ordered as a pair. They will be supplied pre-calibrated. Should field re-calibration be necessary, the following procedure should be followed.

WARNING

THE FOLLOWING PROCEDURE SHOULD ONLY BE ATTEMPTED BY SUITABLY TRAINED AND QUALIFIED PERSONNEL

The procedure assumes that the sensor is connected to the instrument that is switched on and in working order. The procedure should be carried out with the sensor protected from sunlight and the calibration standards are used in the temperature range 20 to 25 degrees Celsius.

17.5.1 Materials and Equipment required:

Item	Qty	Description	Part No.
1	1	500ml bottle 4000 FTU turbidity standard	80-0022-A
2	2	500ml beaker	
3	1 litre	De-ionised water	94-0004-A
4	1	Laboratory stand or suitable holding device to support sensor in beaker	
5	1	Small trim tool suitable for surface mount trim pots	

17.5.2 MLSS Sensor calibration - Method

An ***example*** MSDS for the formazin turbidity standard is supplied in appendix H – Page 308. Refer to the MSDS sheet from your supplier before proceeding.

1. Thoroughly clean all the equipment and the sensor head.

2. Rinse all the components that will be exposed to the Standard with approximately half of the de-ionised water.

3. Dry the 500ml beaker that will be used for the turbidity standard.

4. Place the sensor in the beaker that is still wet from the rinsing operation. The sensor should be stood upright with the optical lenses positioned to be as far away from the sidewall of the beaker as possible. This will prevent reflections from the beaker wall being “seen” by the detectors.

5. Fill the beaker with de-ionised water.

6. Select “Raw SS Volts” on the front panel display using the “YES” & “NO” keys.

7. Adjust **VR2** to read 0.5Volts (clockwise adjustment increases zero).

   See Appendix G for amplifier location within the Main System Assembly and/or LCB.

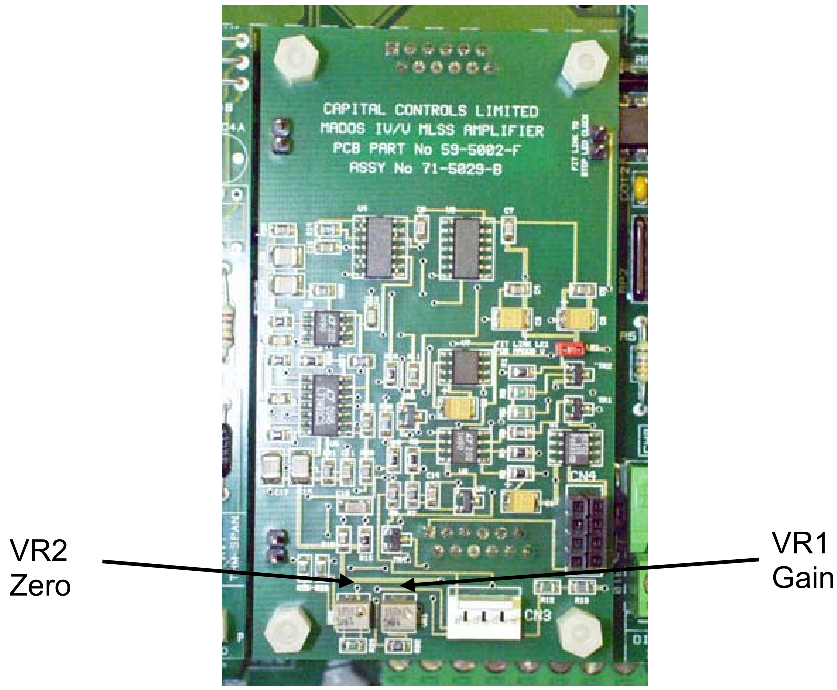


Figure 52 - MLSS amplifier showing setup components

8. Remove the sensor head from the beaker and dry.

9. Place the dried sensor head into the clean, dry beaker orientated as before and fill with 4000FTU standard. Take care to thoroughly but gently mix the standard before dispensing by gently, repeatedly inverting the container. It is important not to entrain any small air bubbles in the solution by this process.

10. Select “RAW FTU” on the front panel display and adjust **VR1** to read 4000 FTU (clockwise adjustment decreases span).

Further checking of the zero and span is not required, but if carried out, care should be taken to prevent cross-contamination of the two standards via any residues adhering to the sensor head.

The amplifier and sensor head are now matched and after returning the instrument to service, a normal, gravimetric calibration and setting of the SETMGL factor via the 3333 menu will be required to make the measurements displayed in mg/l meaningful.

APPENDIX E – DO-MLSS WARRANTY EXCLUSIONS

Because of their consumable nature, certain items are excluded from this warranty and are listed below.

- Air filters
- DO Cell/Sensor cartridge
- DO Sensor membranes and “O” rings
- “O” rings
- DO Cleaning brush

Unless a **Severn Trent Services** authorised engineer installs and commissions the instrument, **Severn Trent Services** has no control over the conditions under which any sensors are used and such the warranty for wet end components is dependent upon correct installation, handling, usage and application.

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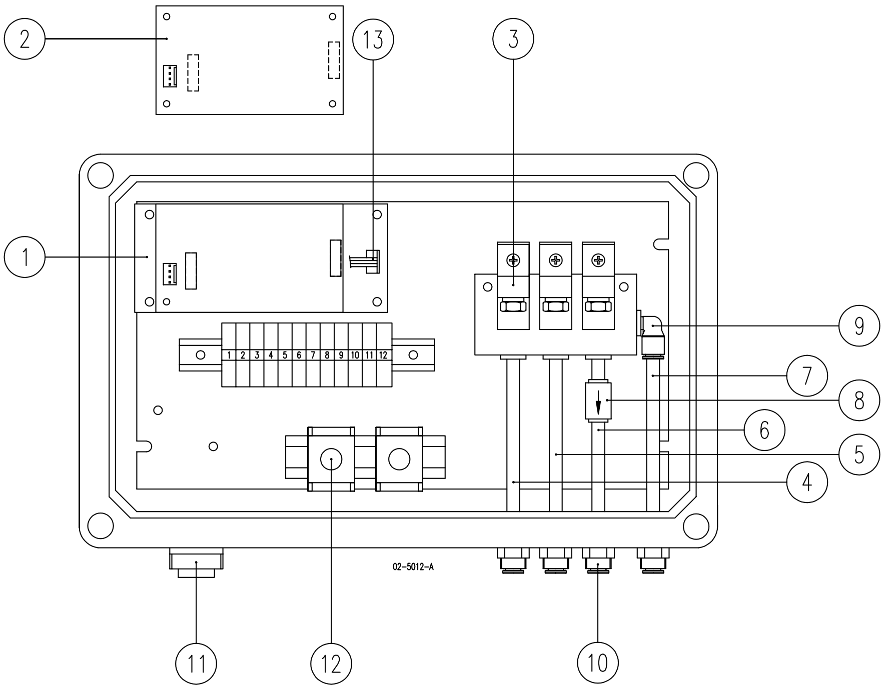
APPENDIX F – DO-MLSS: SPARE PARTS LIST FOR MLSS COMPONENTS



ITEM No.	DRG. CODE No.	DESCRIPTION	No. OFF ASSEMBLY		
			a	b	c
1	71–5032	LCB MLSS AMP ADAPTOR ASSEMBLY	1		
2	71–5029	MADOS IV/V SWITCHABLE MLSS AMPLIFIER	1		
3	29–5004	VALVE c/w 3 SOLENOIDS & LED CAPS	1		
4	26–5003	TUBE NYLON GREEN	A/R		
5	26–5001	TUBE NYLON RED	A/R		
6	26–5002	TUBE NYLON BLUE	A/R		
7	26–5003	TUBE NYLON BLACK	A/R		
8	29–0033	3.0 psi NON–RETURN VALVE	1		
9	25–5023	ELBOW COMPACT STEM 6mm	1		
10	25–5020	6mm BULKHEAD	4		
11	53–5002	SIX PIN PANEL PLUG	1		
12	61–5000	CABLE CLAMP	2		
13	78–5016	MADOS V MLSS OUTPUT RIBBON CABLE ASSEMBLY	1		

FOR FULL ASSEMBLY DRAWING SEE 01–5059

SERIES 5000 MLSS LCB Assembly

ITEM	DESCRIPTION	CODE
	Combination DO/MLSS Sensor Head	01-5014
	Pre-calibrated MLSS Amplifier and Sensor Head Pair	01-5040
	Local Control Box MLSS Amp Adaptor Assembly	71-5032
	MLSS Amplifier Board	71-5033
	Combined DO/MLSS Adaptor Lead	78-5007
	Combined DO/MLSS Connecting Cable	78-5008
	Formazin Turbidity Standard (FTU) Calibration Solution 500ml	80-0022

SERIES 5000 MLSS & DO/MLSS spare parts numbers.

APPENDIX G – TERMINAL DESIGNATIONS, DO-MLSS

Terminal Designations for combined DO-MLSS instruments are almost exactly the same as for the DO-only instruments. The connections are shown in figures

> "Figure 21 - 5.7.3. (i) Terminal Designations for single DO instrument (With & without optional Comms)" on page 45

through to

> "Figure 23 - 5.7.3. (iii) Terminal Designations for double DO instrument with LCB shown overleaf" on page 49

Please refer to these illustrations for further information. The main visible differences with the DO-MLSS instrument are the MLSS amplifier board and the wet end cable splitter an connectors:

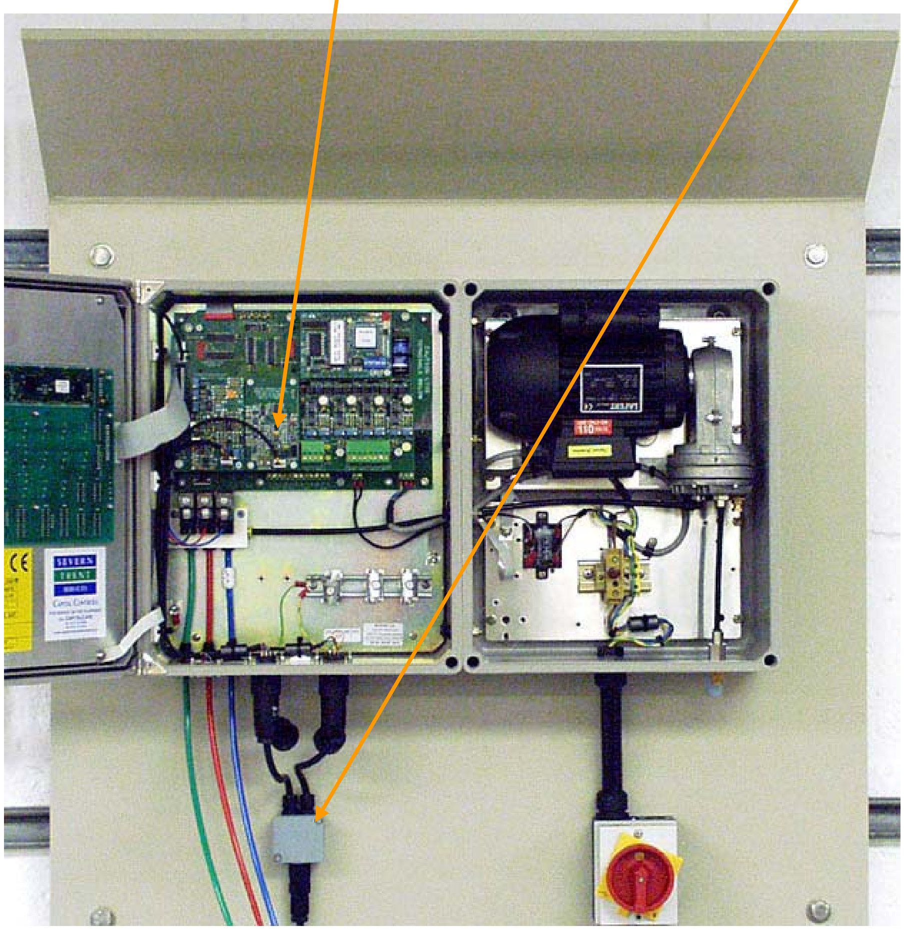


Figure 53 - Location of MLSS amplifier board and cable splitter in DO-MLSS product

APPENDIX H – *Example* MSDS for Formazin Turbidity standard

World Headquarters
Hach Company
P.O.Box 389 *MSDS No: M00482*
Loveland, CO USA 80539
(970) 669-3050

Material Safety Data Sheet

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Formazin Turbidity Standard 4000 FNU

Catalog Number: 246149

Hach Europe by Dr. Bruno Lange GmbH & Co. KG

Willstatterstrasse 11

40549 Dusseldorf, Germany

Emergency Telephone Numbers:

(Poison Information Center Main)
(49) (6131) 19240 24 HR 49-(0)211-52880

MSDS Number: M00482

Chemical Name: Not applicable.

CAS No.: Not applicable

Chemical Formula: Not applicable.

Chemical Family: Not applicable

Date of MSDS Preparation: Day:13 Month:01 Year:2002

Additional Emergency Response Numbers:

Austria: 43-1-4064343, Belgium: 32-70-245245, France: 33-1-40370404, Italy: 39-02-66101029, Netherlands: 31-30-2748888, Switzerland: 41-1-2515151

2. COMPOSITION/INFORMATION ON INGREDIENTS

<u>**Hexamethylenetetramine**</u>

CAS No.: 100-97-0
EEC Number: 2029058
Percent Range: 1.0 –10.0
Percent Range Units: weight/weight
Ingredient EEC Symbol: Xn - HARMFUL
Ingredient R phrase(s): R 42/43
TLV: Not established
PEL: Not established

Demineralized Water

CAS No.:	7732-18-5
EEC Number:	2317912
Percent Range:	90.0 – 100.0
Percent Range Units:	volume / volume
Ingredient EEC Symbol:	Not applicable
Ingredient R phrase(s):	Not applicable
TLV:	Not established
PEL:	Not established

Formaldehyde

CAS No.:	50-00-0
EEC Number:	2000018
Percent Range:	<0.1
Percent Range Units:	weight/weight
Ingredient EEC Symbol:	Not applicable
Ingredient R phrase(s):	Not applicable
TLV: C:	$0.37 mg/m^3$
PEL:	0.75 ppm

Formazin Polymer

CAS No.:	Not available
EEC Number:	Various
Percent Range:	< 100
Percent Range Units:	weight/weight
Ingredient EEC Symbol:	Not applicable
Ingredient R phrase(s):	Not applicable
TLV:	Not established.
PEL:	Not established.

3. HAZARDS IDENTIFICATION

Emergency Overview:

Appearance: Turbid, milky suspension
Odor: None
EU Symbols: Xn - HARMFUL
R PHRASES: R 42/43: May cause sensitization by inhalation and skin contact.

HMIS:

Health ***2***
Flammability: **0**
Reactivity: **0**
Protective Equipment: **X -** See protective equipment, Section 8. ***Potential Health Effects:***

Eye Contact (EC): May cause irritation
Skin Contact (EC): May cause irritation May cause allergic reaction
Skin Absorption (EC): None Reported
Target Organs *(SA* ***E):*** Not applicable

Ingestion (EC): May cause: gastrointestinal tract irritation
Target Organs (Ing E): Not applicable
Inhalation: May cause: allergic skin reaction
Target Organs (Inh E): Not applicable

Medical Conditions Aggravated: Allergies or sensitivity to hexamethylenetetramine.

Chronic Effects: Chronic overexposure may cause symptoms similar to acute exposure.

Cancer/Reproductive Toxicity Information:
This product does NOT contain any IARC listed chemicals.

Additional Cancer / Reproductive Toxicity Information: Contains: an experimental mutagen.

Toxicologically Synergistic Products: None reported

4. FIRST AID

Eye Contact: Immediately flush eyes with water for 15 minutes. Call physician.

Skin Contact *(First aid):* Wash skin with plenty of water. Remove contaminated clothing. Call physician if irritation develops.

Ingestion (First Aid): Induce vomiting using syrup of ipecac or by sticking finger down throat. Never give anything by mouth to an unconscious person. Call physician immediately.

Inhalation: Remove to fresh air.

5. FIRE FIGHTING MEASURES

Flammable Properties: During a fire, this product decomposes to form toxic gases.
Hazardous Combustion Products: Toxic fumes of: ammonia formaldehyde nitrogen oxides, carbon monoxide, carbon dioxide.
Fire/Explosion Hazards: None reported
Static ***Discharge:*** None reported.
Mechanical Impact: None reported
Extinguishing Media: Use media appropriate to surrounding fire conditions
Fire Fighting Instruction: As in any fire, wear self-contained breathing apparatus pressure-demand and full protective gear.

6. ACCIDENTAL RELEASE MEASURES

Spill Response *Notice:*

Only persons properly qualified to respond to an emergency involving hazardous substances should respond to a spill involving chemicals. See Section 13, Special Instructions for disposal assistance.

Containment Technique: Absorb spilled liquid with non-reactive sorbcnt material. Dike large spills to keep spilled material from entering sewage and drainage systems or bodies of water.

Clean-up Technique: Absorb spilled liquid with non-reactive sorbent material. Sweep up material. Place material in a plastic bag. Mark bag Non-hazardous trash', and dispose of as normal refuse. Decontaminate the area of the spill with a soap solution.

Evacuation Procedure: Evacuate as needed to perform spill clean-up. If conditions warrant, increase the size of the evacuation. ***D.O.T. Emergency Response Guide Number:*** Not applicable.

7.HANDLING / STORAGE

Handling: Avoid contact with eyes skin Do not breathe mist or vapors. Wash thoroughly after handling. Maintain general industrial hygiene practices when using this product

Storage: Keep container tightly closed when not in use. Protect from: heat

8. EXPOSURE CONTROLS / PROTECTIVE EQUIPMENT

Engineering Controls: Have an eyewash station nearby. Maintain general industrial hygiene practices when using this product.

Personal Protective Equipment:

Eye Protection:	safety glasses with top and side shields
Skin Protection:	disposable latex gloves
Inhalation Protection:	adequate ventilation

Precautionary Measures: Avoid contact with: eyes skin Do not breathe: mist/vapor Wash thoroughly after handling.

TLV:	Not established.
PEL:	Not established.

9. PHYSICAL / CHEMICAL PROPERTIES

Appearance:	Turbid, milky suspension
Physical State:	Liquid
Odor:	None
pH:	*6.4*
Vapor Pressure:	Not determined.
Vapor Density (air = 1):	Not determined.
Boiling Point:	~ 100°C (~212°F)
Melting Point:	Not applicable.
Flash Point:	Not applicable.
Method:	Not applicable
Autoignition Temperature:	Not determined.
Flammabuity Limits:	
Lower Explosion Limits:	Not applicable.
Upper Explosion Limits:	Not applicable.
Specific Gravity (water = l):	1.002
Evaporation Rate (water = l):	0.63
Volatile Organic Compounds Content:	Not determined.
Partition Coefficient (n-Octanol/water):	Not applicable.
Solubility:	
Waters:	Miscible.
Acid:	Miscible.
Other:	Not determined.

Metal *Corrosivity:*

Steel:	Not determined.
Aluminum:	Not determined.

10. STABILITY / REACTIVITY

Chemical Stability:	Stable when stored under proper conditions.
Conditions to Avoid:	Extreme temperatures
Reactivity/Incompatibility:	Incompatible with: oxidizers
Hazardous Decomposition:	Heating to decomposition releases: ammonia carbon monoxide formaldehyde nitrogen oxides
Hazardous Polymerization:	Will not occur.

11. TOXICOLOGICAL INFORMATION

Product Toxicological Data:

LDSO:	Oral rat LD50 > 5000 mg/kg
LC50:	None reported.
Dermal Toxicity Data:	None reported.
Skin and Eye Irritation Data:	None reported.
Mutation Data:	None reported.
Reproductive Effects Data:	None reported.

Ingredient Toxicological Data:

Hexamethylenetetramine:	Oral mouse LDLo =512 mg/kg.

12. ECOLOGICAL INFORMATION

Product Ecological Information:	No specific ecological information available
Ingredient Ecological Information:	Hexamethylenetetramine:
Water Pollution Factors:	**BOD5:** 0.015; 0.026 std. dil. sew.

13. DISPOSAL CONSIDERATIONS

Special Instructions (Disposal): Dilute material with excess water making a weaker than 5% solution. Open cold water tap completely, slowly pour the material to the drain. Flush system with plenty of water.

Empty Containers: Rinse three times with an appropriate solvent Dispose of empty container as normal trash.

NOTICE (Disposal): These disposal guidelines arc based on federal regulations and may be superseded by more stringent state or local requirements. Please consult your local environmental regulators for more information.

14. TRANSPORT INFORMATION

LC.A.O.:
LC.A.O. Proper Shipping Name: Not Currently Regulated

ICAO Hazard Class: **NA**
ICAO Subsidiary Risk: **NA**
ICAO ID Number:*'*NA**
ICAO Packing Group: **NA**
LM.O.:
LM.O. Proper Shipping Name: Not Currently Regulated

LM.O. Hazard Class: **NA**
LM.O. Subsidiary Risk: **NA**
LM.O. ID Number: **NA** ***LM.O.***
Packing Group: **NA** ***A.D.R.:***
A.D.R. Proper Shipping Name: Not Currently Regulated

A.D.R Hazard Class: **NA**
A.D.R. Subsidiary Risk: **NA**
A.D.R. ID

Number:: **NA**

15. REGULATORY INFORMATION

National Inventories:

EEC Inventory Status:	All ingredients used to make this product are listed on EINECS / ELINCS.
EEC Number:	Not applicable.
EEC LABEL COPY:	
EU Symbols:	Xn - HARMFUL
R PHRASES: R 42/43:	May cause sensitization by inhalation and skin contact.
SPEKASES: S24:	Avoid contact with skin. S 37: Wear suitable gloves.
BAG T Number:	610200
Poison Class:	Free

16. OTHER INFORMATION

Intended Use: Standard solution

References: 29 CFR 1900-1910 (Code of Federal Regulations - Labor). Air Contaminants, Federal Register, Vol. 54, No. 12. Thursday, January 19,1989. pp. 2332-2983. CCINFO RTECS. Canadian Centre for Occupational Health and Safety. Hamilton, Ontario Canada: 30 June 1993. Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Fire Protection Guide on Hazardous Materials, 10th Ed. Quincy, MA: National Fire Protection Association, 1991. IARC Monographs on the Evaluation of the Carcinogenic Risks to Humans. World Health Organization (Volumes 1-42) Supplement 7. France: 1987. Lefevre, Marc J. First Aid Manual for Chemical Accidents, 2nd Ed. New York; Van Nostrand Reinhold Company, 1989. List of Dangerous Substances Classified in Annex I of the EEC Directive (67/548) - Classification, Packaging and Labeling of Dangerous Substances, Amended July 1992. Sixth Annual Report on Carcinogens, 1991. U.S. Department of Health and Human Services. Rockville, MD: Technical Resources, Inc. 1991. Technical Judgment TLV's Threshold Limit Values and Biological Exposure Indices for 1992-1993. American Conference of Governmental Industrial Hygienists, 1992. Verschueren, Karel. Handbook of Environmental Data on Organic Chemicals. New York: Van Nostrand Reinhold Co., 1977.

Legend:	NA - Not Applicable	w/w - weight/weight
	ND - Not Determined	w/v - weight/volume
	NV - Not Available	v/v - volume/volume

USER RESPONSIBILITY: Each user should read and understand this information and incorporate it in individual site safety programs in accordance with applicable hazard communication standards and regulations.

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